IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	)	
	)	
Jeffery A. LUCAS	)	Group Art Unit: 1723
	)	Examiner: K. Keeler
Serial No.: 10/669,533	)	
	)	
Filed: Sept. 24, 2003	)	
	)	
For: ***Multi-Layer Pleat Support Filter Construction***	)	

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Mary K. Rudaitis

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPEAL BRIEF

In re Application of:	)	
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Jeffery A. LUCAS et al.	)	
	)	Group Art Unit: 1723
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For: **MULTI-LAYER PLEAT SUPPORT FILTER CONSTRUCTION**	)	

Assistant Commissioner of Patents and Trademarks,
Washington, DC 20231

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SIR:

In response to the Advisory Action Before the Filing of an Appeal Brief of June 27, 2005, please enter this Appeal Brief.

I. INTRODUCTION

In accordance with the provisions of 35 U.S.C. § 134 and 37 C.F.R. §§ 1.191 and 1.192, this Appeal Brief is submitted in triplicate in support of an Appeal from the Final Office Action dated April 1, 2005, finally rejecting Claims 1-22 and the Advisory Action dated June 27, 2005, in which the Examiner entered Appellant's Amendment filed on June 1, 2005.

A. Real Party In Interest

Appellants have assigned their interests in the subject Application to CUNO Incorporated by an assignment recorded in the U.S. Patent and Trademark Office at Reel 014541, Frame 0874. CUNO Incorporated was subsequently acquired by 3M Corporation, and operates as a wholly owned subsidiary of 3M Corporation.

B. Related Appeals and Interferences

None.

II. STATUS OF THE CLAIMS

A. Status of Pending Claims

Claims 1-17 and 20-22 are now pending in this Application, with claims 18-19 having been withdrawn. In the Official Action dated April 1, 2005 Claims 1-22 were finally rejected under 35 U.S.C. § 103(a). Thus, for the purposes of appeal, Claims 1-22 stand rejected (claims 1-17 and 20-22 are believed to be the claims actually rejected) and arguments are presented herein to overcome the rejection to these claims (1-17 and 20-22).

B. Status of Cancelled Claims

Claims 18 and 19 were withdrawn during prosecution of the subject Application.

III. STATUS OF THE AMENDMENTS

In an Office Action dated April 1, 2005, Claims 1-17 and 20-22 were finally rejected under 35 U.S.C. § 103(a).

Appellant responded to the Office Action (Final Rejection) in an Amendment under **37 C.F.R. § 1.116** filed June 1, 2005 and June 21, 2005 addressing each of the Examiner's rejections.

In response, the Examiner issued an Advisory Action Before the Filing of an Appeal Brief dated June 27, 2005 entering Appellant's June 2005 Amendment providing an explanation of how the new or amended claims would be rejected. As to the reasons for believing that the amended claims would be rejected, the Examiner stated as follows:

> The request for reconsideration has been considered but does not place the application in condition for allowance because:
>
> 1. The Examiner has reviewed the file and applicant's arguments and maintains that the Miller reference teaches an extruded netting and Miller in view of Pall teaches an extruded apertured film, wherein Pall discloses (column 4, lines 33-37) his extruded netting as an extruded film that is later punched to produce an apertured film.
>
> 2. It is unclear how applicant's claimed "extruded apertruded film" and preferred material of manufacture for the second downstream support Delstar Delnet differs structurally from Miller in view of Pall's extruded apertured film.

As a result, Appellant filed a Notice of Appeal on July 1, 2005.

IV. SUMMARY OF THE CLAIMED INVENTION

Figures 1-3, the only figures of the present application, show a sectional view of a representative embodiment as described by the claims. The embodiment disclosed in Figure 1 is a perspective view, partially cutaway, of a cartridge assembly including a pleated filter element constructed in accordance with an exemplary embodiment of the present disclosure contained between an inner core and an outer cage of the cartridge assembly wherein a portion of the filter element is shown unwrapped from within the cage. Figure 2 shows a perspective, partially exploded, view of a

portion of an exemplary filter element, illustrating the multi-layer structure thereof; and Figure 3 shows a schematic cross-sectional illustration showing fluid flow relative to an exemplary filter element according to the present disclosure.

Appellant's claimed invention is best understood with reference to the representative embodiment described and illustrated in Appellant's specification. In particular and referring to Figure 1, a pleated filter cartridge constructed according to the invention and designated generally by reference numeral 10.

Filter cartridge 10 includes an elongated pleated filter element 12 having a plurality of longitudinal pleats 14 surrounding a central perforated core 20 coaxially disposed within the filter element and a perforated outer cage 30 coaxially disposed on the filter element. The core 20 supports the inner periphery of the filter element 12 against forces in the radial direction and also helps to give the filter axial strength and rigidity against bending. The cage 30 retains the pleats of the filter element 10, preferably in a radial pleat configuration. It is possible to employ means other than cage 30 to retain the pleats as, for example, a polymeric netting or mesh material may be utilized to retain the pleats about the outer periphery of filter element 12. Usually a cartridge assembly 10 will be equipped with end caps at both ends. The end caps 40 can be either closed or open end caps and the materials of which they are formed and their shape are selected depending on the filtering conditions and the materials of the members to which they are to be joined.

When the filter element 12 is used under conditions where the fluid flows radially inwardly through the filter element, i.e., from the cage 30 to the core 20, the internal surfaces of the pleat legs form the downstream surface of the filter element 12, while the external surfaces of the pleat legs form the upstream surface of the filter element 12. Conversely, when the filter element 12 is used under conditions such that fluid flows radially outwardly through the element, i.e., from the core to the cage, the internal surfaces of the pleat legs define the upstream surface of the filter element 12 and the external surfaces of the pleat legs define the downstream surface of the filter element 12. More specifically, as used herein, upstream and downstream refer to the exterior and interior surfaces of the filter element 12 when the filter element is being subject to radially outward fluid flow.

Filtration element 12 includes an upstream pleat support 16, a filtration media 18, a multi-layer downstream support that includes a first downstream support layer 19 and a second downstream support layer 22. Selection of an upstream pleat support 16 is not critical to filtration performance and its selection generally depends upon a number of factors, namely, requirements associated with the upstream support's ability to maintain flow under dirt loading, the required

chemical resistance of the upstream support, and/or conditions associated with potential damage to the filtration media caused by the upstream support.

The filtration media 18 may take a variety of pleated forms, the filtration media 18 may define radial pleats, W-pleats or spiral pleats.

There are no particular restrictions on the type of filter medium 18 that can be employed in the present filter element 12 and the filter medium can be selected in accordance with the fluid to be filtered and the desired filtering characteristics. The filter medium 18 can be used to filter fluids such as liquids, gases, or mixtures thereof, and may comprise a porous film or a fibrous sheet or mass, or any combination thereof, may have a uniform or graded pore structure and any appropriate effective pore size; may include single or multiple layers; and may be formed from any suitable material, such a natural material, synthetic polymer, glass or metal.

According to preferred embodiments of the present disclosure, the filter medium is comprised of one or more sheets of non-woven thermoplastic microfibers. The nonwoven thermoplastic microfibers may be meltblown, spunbond, spunlace, carded or hydroentangled, for example. In addition, the filter medium may be calendered, or compressed, to further modify its porosity. For lower temperature filtering applications (i.e., below 180° F.), the thermoplastic can comprise polypropylene, for example, while for higher temperature applications (i.e., above 180° F.) or chemical compatibility with other fluids, the thermoplastic can comprise polyaramide, nylon, polyester or melt-processible fluoropolymer, for example.

The filtration media 18 is typically a microporous filtration media having a pore size of about 0.1 microns to about 10 microns, and is generally fabricated from conventional filtration materials, such as expanded Teflon, nylon, polyether sulfone, polyvinylidene difluoride and the like.

The pore size of filtration media 18 is generally characterized by bubble point tests, which involve measuring the pressure to force either the first air bubble out of a fully wetted phase inversion membrane (the initial Bubble Point, or "IBP"), and the higher pressure which forces air out of the majority of pores all over the phase inversion membrane (foam-all-over-point or "FAOP"). The procedures for conducting initial bubble point and FAOP tests are discussed in U.S. Patent No. 4,645,602, the disclosure of which is incorporated herein by reference. The procedure for the initial bubble point test and the more common Mean Flow Pore tests are explained in detail, for example, in ASTM F316-70 and ANS/ASTM F316-70 (Reapproved 1976),

Appellant's claimed invention is directed to a new filter element constructed which comprises a filtration media, an upstream pleat support positioned upstream and in contact with the filtration media, multi-layer downstream pleat supports positioned downstream from the filtration media,

including a first downstream support layer and a second downstream support layer, the first downstream support layer is in contact with the filtration media and is interposed between the filtration media and the second downstream layer, with the first downstream support layer having been fabricated so as to minimize points of surface contact with the filtration media. The second downstream support layer is in contact with the first downstream support layer and is fabricated so as to facilitate lateral fluid flow relative to the multi-layer downstream pleat support.

More particularly, the multi-layer downstream pleat support includes a first downstream support layer and a second downstream support layer. The first downstream support layer is interposed between the filtration media and the second downstream support layer and is fabricated so as to minimize points of surface contact with the filtration media, thereby enhancing fluid flow away from the filtration media. The first downstream support is fabricated from a material that contacts the membrane in as few locations as possible so as to allow the fluid, whether it be liquid or gas, to egress from the filtration media and into the second downstream support layer located just below. Suitable materials for use in fabricating the first downstream support layer are non-woven materials characterized by high air permeability, low thickness, high strength, low fiber diameter and/or a relatively soft feel to prevent abrasion of the filtration media. Preferred examples of materials for fabricating the first downstream support layers are polypropylene or polyesters. In an alternative embodiment, the first downstream support layer can be fabricated of a nonwoven material that is laminated to the filtration media. However, it is generally preferred to provide the first downstream support layer in non-laminated juxtaposition relative to the filtration media, thereby improving flow through the first support layer and the filtration media, e.g., by as much as 3 to 5%.

The second downstream support layer is in contact with the first downstream support layer and is fabricated so as to facilitate lateral fluid flow. Preferably, the second downstream support layer is fabricated from an **extruded apertured film material**, and preferably an apertured film material **having rib(s) formed on one side**. The **rib(s)** advantageously maintain a gap when the pleated filtration media is folded onto itself, **thereby greatly improving lateral fluid flow**. [Emphasis added]

The inventors herein have established (infra) that eliminating either the first or the second downstream support layer will degrade the performance of the filter. The first downstream support layer, which is typically fabricated from a nonwoven material, does not provide optimum lateral flow. Likewise, the extruded apertured film would disadvantageously effect a sealed contact against the filtration media if placed directly against it, thereby limiting fluid egress from the filtration media to aperture locations. The addition of the support layers to the filter design allows an increase in the media area without resorting to different pleat designs, larger

geometries or ever thinner supports, despite the fact that the additional support layers effectively add thickness. The relatively thin filtration media is capable of increased packing by pressing the pleats together more closely, but in prior art systems, the increased area associated with tight packing does not result in increased flow because the support materials are closely pinched together. It has now been found that when multiple downstream support layers are employed, as described in the present disclosure, the higher filtration area will beneficially lead directly to improved flow because the transport of the fluid from the downstream layers to the core will not be impeded. However, even when the filler element is constructed with less filtration area, the construction in accordance with the invention provides improved flow rate and improved flux, i.e., flow per area.

The filtration media may take a variety of forms, as are known in the art. Pleated filtration media having a plurality of longitudinally extending pleats may be advantageously incorporated into filter elements according to the present disclosure. The specific pleat geometry is not critical to the superior performance achievable according to the present disclosure. Radial pleats, W-pleats and spiral pleats are exemplary pleat geometries contemplated for use herein.

According to the present disclosure, advantageous filter elements provided offer superior filtration performance including **improved flow** for a given filter cartridge size/design, the latter being achieved through the **selection** of support materials that act cooperatively **to improve total flow**. [Emphasis added]

Appellant's claimed invention differs from the conventional arrangement in that Appellants believe that the support materials selected, **apertured films** are fundamentally **distinct** from extruded mesh materials in both their design and the processes used to manufacture them. Apertured films typically contain primary strands or ribs that run in the down web machine direction while the extruded meshes contain primary ribs or strands that only run diagonal to the down web machine direction. Apertured films are manufactured using a process similar to that used to produce biaxial oriented films while extruded mesh is manufactured using a counter-rotating die technology that places the strands in two different planes.

A further distinction between the apertured film and the extruded mesh is the greater ability of the apertured film to "**nest**" when folded. When a material containing a 3-dimensional structure is folded onto itself, and when measured produces a thickness less than the sum of the 2 layers measured independently, then a "**nesting**" condition of the strands or ribs is taking place. The apertured film exhibits the greatest ability for the strands or ribs to "**nest**" due to the primary strand or rib formation running in the machine direction. This rib nesting capability allows for the maximum surface area in the filter's design. In contrast, the extruded mesh possesses a

diagonal strand relative to the machine direction that, when folded in the machine direction, provides only limited "nesting" capability of the ribs.

V. ISSUE

The single issue raised in the Final Rejection requiring resolution in this Appeal is as follows:

> Whether Appellant's pending claims are patentable under 35 U.S.C. § 103(a) over Miller et al (U.S. Patent No. 5,275,743) in view of Pall (U.S. Patent No. 4,033,881).

VI. GROUPING OF CLAIMS ON APPEAL

The claims on appeal before the Board of Patent Appeals and Interferences are Claims 1-17 and 20-22. All of the claims relate to a filter element, comprising: a filtration media; an upstream filtration media support positioned upstream from and in contact with the filtration media; and a multi-layer downstream filtration media support positioned downstream from the filtration media, the multi-layer downstream support including a first downstream support layer and a second downstream support layer, wherein: the first downstream support layer is in contact with the filtration media and is interposed between the filtration media and the second downstream layer, the first downstream support layer is fabricated so as to minimize points of surface contact with the filtration media; and the second downstream support layer is in contact with the first downstream support layer and is fabricated so as to facilitate lateral fluid flow relative to the multi-layer downstream pleat support, wherein the second downstream support layer comprises an extruded apertured film having **ribs**. The claims on appeal are set forth in the Appendix, and a representative independent claim, Claim 11 is set forth below:

> 1. A filter element, comprising:
>
> a filtration media;
>
> an upstream filtration media support positioned upstream from and in contact with the filtration media; and
>
> a multi-layer downstream filtration media support positioned downstream from the filtration media, the multi-layer downstream support including a first downstream support layer and a second downstream support layer, wherein:
>
> the first downstream support layer is in contact with the filtration media and is interposed between the filtration media and the second downstream layer, the first downstream

support layer is fabricated so as to minimize points of surface contact with the filtration media; and

the second downstream support layer is in contact with the first downstream support layer and is fabricated so as to facilitate lateral fluid flow relative to the multi-layer downstream pleat support, wherein the second downstream support layer comprises **an extruded apertured film having ribs**. [Emphasis added]

Pursuant to 37 C.F.R. § 1.192(c)(7), Appellant hereby groups the pending claims for purposes of appeal as follows:

35 U.S.C. § 103(a): Rejected claims stand or fall together.

VII. APPELLANT'S ARGUMENTS

A. Background Discussion:

In the initial rejection of claims 1-4, 6, 7, 9, 10, 12-14, 16, 17, and 20-22 under 35 U.S.C. 102 (b) The examiner has suggested that original claim 1 was not distinguished from Miller (743). In the Official Action, the Examiner rejected Claims 1-4, 6, 7, 9, 10, 12-14, 16, 17, 20-22 as being anticipated by Miller et al. (U.S. Patent No. 5,275,743) and stated as follows:

> Claims 1-4, 6, 7, 9, 10, 12-14, 16, 17, 20-22 are rejected under 35 U.S.C. 102 (b) as being anticipated by Miller ET al. (U.S. Patent No. 5,275,743).
>
> Independent claim 1 recites, "a multi-layer downstream filtration media support" (line 5) and "said multi-layer downstream pleat support" (line 14). It is unclear whether the support is intended to claim a "pleat" structure. Since the base claim 1 in other instances and its dependent claim fail to recite such a recitation, claim 1 has been examined based on the first cited reference above for the support structure.
>
> Miller (743) teaches a filter element (10), comprising a filtration media (22), an upstream filtration media support (21) positioned upstream from and in contact with said filtration media (22) and a multi-layer downstream filtration media support (23,24) positioned downstream from said filtration media (22), said multi-layer downstream support (23,24) including a first downstream support layer (23) and a second downstream support layer (24), wherein: said first downstream support layer (23) is in contact with said filtration media (22) and is interposed between said filtration media (22) and said second downstream layer (24). The first downstream support layer (23) is fabricated so as to minimize points of surface contact with said filtration media (22); and said second

downstream support layer (24) is in contact with said first downstream support layer (23) and is fabricated so as to facilitate lateral fluid flow relative to said multi-layer downstream media support (23, 24) as recited in claim 1. As to claim 2, Miller (743) discloses filter element wherein the filtration media is a pleated filtration media having a plurality of longitudinally extending pleats in column 8 lines 66-68. Miller (743) teaches the use of a pleated filtration media (column 2 lines 32-36) selected from the group consisting of radial pleats, w-pleats and spiral pleats (column 5 lines 28-31) as recited in claim 3. As to claim 4, Miller (743) describes a filter element as recited in Claim 1 in column 2 lines 58-64, wherein the filtration media is a microporous filtration membrane having a pore size of 10 microns or less. As to claim 6, Miller (743) describes, column 3 lines 58-63, the multi-layer downstream support consisting of said first downstream support layer and said second downstream support layer. Miller (743) also describes the first downstream support layer is fabricated from a nonwoven material in column 3 lines 61-63 as recited in claim 7. As to claim 9, Miller (743) states said nonwoven material is fabricated as a wetlaid material in column 2 line 17. Miller (743) also states said nonwoven material is fabricated from polyester in column 4 line 24, as recited in claim 10.

As to claim 12, Miller (743) teaches a filter element (10), comprising a filtration media (22), an upstream pleat support (21) positioned upstream from and in contact with said filtration media (22) and a multi-layer downstream pleat support (23,24) positioned downstream from said filtration media (22), said multi-layer downstream support (23,24) including a first downstream support layer (23) and a second downstream support layer (24), wherein said first downstream support layer (23) is in contact with said filtration media (22) and is interposed between said filtration media (22) and said second downstream layer (24). The first downstream support layer (23) is fabricated so as to minimize points of surface contact with said filtration media (22); and said second downstream support layer (24) is in contact with said first downstream support layer (23) and is fabricated so as to facilitate lateral fluid flow relative to said multi-layer downstream pleat support (23, 24).

As to claim 13, Miller (743) also teaches a filter cartridge comprising a filter element (10) having a longitudinal axis, an outer periphery and an inner periphery, and including a filtration media (22), an upstream filter media support (21) positioned upstream from and in contact with said filtration media (22); and a multi-layer downstream support (23,24) positioned downstream from said filtration media (22), said multi-layer downstream support (23,24) including a first downstream support layer (23) and a second downstream support layer (24), wherein the first downstream support layer (23) is in contact with said filtration media (22) and is interposed between said filtration media (22) and said second

downstream layer (24), said first downstream support layer (23) being fabricated so as to minimize points of surface contact with said filtration media (22). The second downstream support layer (24) is in contact with said first downstream support layer (23) and is fabricated so as to facilitate lateral fluid flow relative to said multi-layer downstream filter media support (23, 24); a perforated cage (11) surrounding the outer periphery of the filter element; a perforated core (12) surrounded by the inner periphery of the filter element; and end caps (13, 14) enclosing both ends of the perforated cage (11). Miller (743) also describes the first downstream support layer is fabricated from a nonwoven material in column 3 lines 61-63 as recited in claim 14. As to claim 16, Miller (743) states said nonwoven material is fabricated as a wetlaid material in column 2 line 17. Miller (743) also states said nonwoven material is fabricated from polyester in column 4 line 24, as recited in claim 17. As to claim 20, Miller (743) discloses in Figure 1 a perforated cage (11) is equipped with end caps (13, 14) at both ends thereof. As to claim 21, Miller (743) discloses in Figure 1 said perforated core (12) is a cylindrical core and is coaxially positioned within the filter element, which is a cylindrical filter element, and the cage (11) is likewise cylindrical and is coaxially positioned about the cylindrical filter element.

As to claim 22, Miller (743) also teaches a filter cartridge comprising a filter element (10) having a longitudinal axis, an outer periphery and an inner periphery, and including a filtration media (22), an upstream filter pleat support (21) positioned upstream from and in contact with said filtration media (22); and a multi-layer downstream support (23,24) positioned downstream from said filtration media (22), said multi-layer downstream support (23,24) including a first downstream support layer (23) and a second downstream support layer (24), wherein the first downstream support layer (23) is in contact with said filtration media (22) and is interposed between said filtration media (22) and said second downstream layer (24), said first downstream support layer (23) being fabricated so as to minimize points of surface contact with said filtration media (22). The second downstream support layer (24) is in contact with said first downstream support layer (23) and is fabricated so as to facilitate lateral fluid flow relative to said multi-layer downstream filter pleat support (23, 24); a perforated cage (11) surrounding the outer periphery of the filter element; a perforated core (12) surrounded by the inner periphery of the filter element; and end caps (13, 14) enclosing both ends of the perforated cage (11).

Appellant responded to the above rejections and other rejections of the remaining claims under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 6,136,189 to Miller et al. in view of several other U. S. Patents as follows:

Applicants hereby traverse the Examiner's 35 U.S.C. §102 rejections and respectfully submit that all currently pending claims are patentably distinguishable over Miller et al. Concerning the 35 U.S.C. § 102(b) rejections, as the Examiner knows, MPEP §2131 provides:

> "A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described in a single prior art reference." *Verdegaal Bros. v. Union Oil Co. Of California,* 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). "The identical invention must be shown in as complete detail as contained in the ... claim." *Richardson v. Suzuki Motor Co.,* 868 F.2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989). The elements must be arranged as required by the claim.

As stated by the Examiner, Miller et al. does not disclose all elements of any of the present independent claims of the above-referenced application, either explicitly or inherently. Specifically, Miller et al. is silent as to the **second downstream support layer being an extruded apertured element**. Miller (743) also does not teach the extruded layer having ribs formed on one side. However, the Examiner alleges that Pall (881) does teach an extruded support layer (column 3 lines 63-66) and further teaches an extruded support layer with ribs (column 4 lines 12-14). Pall (881) states as follows "external and interior supports can be made of metal or plastic, and can be, for example, in the form of perforated sheets or plates, or woven or nonwoven or extruded netting, made of plastic filaments or extrusions". After these assertions, the Examiner concludes that It would have been obvious to one of ordinary skill to manufacture the support layer in an extruded fashion because Pall discloses several options regarding the manufacture of the second support layer including plastic, nonwoven, woven, and extruded.

Applicants respectfully disagree. Specifically, applicants have amended the independent claims to require, among other features, that the second downstream support layer comprises an extruded apertured film having ribs. Applicants respectfully submit that such feature is not disclosed by Miller et al and cannot constitute anticipation because not every element of the present independent claims is present in the Miller et al reference and an action acknowledging same is respectfully requested.

In response to Appellant's response, the Examiner finally all claims pending as follows:

> 4. As to claim 1, Miller ('743) teaches a filter element (10), comprising a filtration media (22), an upstream filtration media support (21) positioned upstream from and in contact with said filtration media (22) and a multi-layer downstream filtration media support (23,24) positioned downstream from said filtration media

(22), said multi-layer downstream support (23,24) including a first downstream support layer (23) and a second downstream support layer (24), wherein: said first downstream support layer (23) is in contact with said filtration media (22) and is interposed between said filtration media (22) and said second downstream layer (24). The first downstream support layer (23) is fabricated so as to minimize points of surface contact with said filtration media (22); and said second downstream support layer (24) is in contact with said first downstream support layer (23) and is fabricated so as to facilitate lateral fluid flow relative to said multi-layer downstream media support (23,24). Miller further teaches a polymeric mesh material of manufacture for the second downstream layer and more specifically states a suitable polymeric mesh, such as, Naltex and Zicot. Both of these meshes/nettings are known in the art as an extruded mesh/net. See the Delstar website at www.delstarinc.com for information regarding Naltex and US Patent 5,725,784 column 7 lines 6-8 to Geibel et al regarding Zicot. Miller is silent to the extruded polymeric mesh having ribs. However, **Pall ('881)** teaches a pleated filter cartridge with upstream and downstream support members fabricated from **extruded netting with ribs** in column 3 lines 63-66 and column 4 lines 12-14. It is considered to have been obvious to one of ordinary skill in the art to fabricate the downstream support layer from an **extruded mesh/net** with ribs because an **extruded mesh/net** is a conventional material of manufacture for the downstream support layer and the ribs provide the support layer with reinforcement useful in pressurized filtration systems, such as, Miller and Pall's. (Emphasis added)

5. As to claim 2, Miller ('743) discloses a filter element wherein the filtration media is a pleated filtration media having a plurality of longitudinally extending pleats in column 8 lines 66-68, which meet's applicant's claim.

6. As to claim 3, Miller ('743) teaches the use of a pleated filtration media (column 2 lines 32-36) selected from the group consisting of radial pleats, w-pleats and spiral pleats (column 5 lines 28-31), which meet's applicant's claim.

7. As to claim 4, Miller ('743) describes a filter element in column 2 lines 58-64, wherein the filtration media is a microporous filtration membrane having a pore size of 10 microns or less, which meet's applicant's claim.

8. As to claim 6, Miller ('743) describes, column 3 lines 58-63, the multi-layer downstream support consisting of said first downstream support layer and said second downstream support layer, which meet's applicant's claim.

9. As to claim 7, Miller ('743) also describes the first downstream support layer is fabricated from a nonwoven material in column 3 lines 61-63, which meet's applicant's claim.

10. As to claim 9, Miller ('743) teaches said nonwoven material is fabricated as a wetlaid material in column 2 line 17, which meet's applicant's claim.

11. As to claim 10, Miller ('743) also states said nonwoven material is fabricated from polyester in column 4 line 24, which meet's applicant's claim.

12. As to claim 12, Miller ('743) teaches a filter element (10), comprising a filtration media (22), an upstream pleat support (21) positioned upstream from and in contact with said filtration media (22) and a multi-layer downstream pleat support (23,24) positioned downstream from said filtration media (22), said multi-layer downstream support (23,24) including a first downstream support layer (23) and a second downstream support layer (24), wherein said first downstream support layer (23) is in contact with said filtration media (22) and is interposed between said filtration media (22) and said second downstream layer (24). The first downstream support layer (23) is fabricated so as to minimize points of surface contact with said filtration media (22); and said second downstream support layer (24) is in contact with said first downstream support layer (23) and is fabricated so as to facilitate lateral fluid flow relative to said multi-layer downstream pleat support (23,24). Miller further teaches a polymeric mesh material of manufacture for the second downstream layer and more specifically states a suitable polymeric mesh, such as, Naltex and Zicot. Both of these meshes/nettings are known in the art as an extruded mesh/net. See the Delstar website at www.deistarinc.com for information regarding Naltex and US Patent 5,725,784 column 7 lines 6-8 to Geibel et al regarding Zicot. Miller is silent to the extruded polymeric mesh having ribs. However, Pall ('881) teaches a pleated filter cartridge with upstream and downstream support members fabricated from extruded netting with ribs in column 3 lines 63-66 and column 4 lines 12-14. It is considered to have been obvious to one of ordinary skill in the art to fabricate the downstream support layer from an **extruded mesh/net** with ribs because an **extruded mesh/net** is a conventional material of manufacture for the downstream support layer and the ribs provide the support layer with reinforcement useful in pressurized filtration systems, such as, Miller and Pall's. (Emphasis added)

13. As to claim 13, Miller ('743) also teaches a filter cartridge comprising a filter element (10) having a longitudinal axis, an outer periphery and an inner periphery, and including a filtration media (22), an upstream filter media support (21) positioned upstream from and in contact with said filtration media (22); and a multi-layer downstream support (23,24) positioned downstream from said filtration media (22), said multi-layer downstream support (23,24) including a first downstream support layer (23) and a second downstream support layer (24), wherein the first downstream support layer (23) is in contact with said filtration media (22) and is interposed between said filtration media (22) and said second downstream layer (24), said first downstream support layer (23) being fabricated so as to minimize points of surface contact with said filtration media (22). The second downstream support layer (24) is in contact with said first downstream support layer (23) and is fabricated so as to facilitate lateral fluid flow relative to said multi-layer downstream filter media support (23,24); a perforated cage (11) surrounding the outer periphery of the filter element; a perforated core (12) surrounded by the inner periphery of the filter element; and end caps (13,14)

enclosing both ends of the perforated cage (11). Miller further teaches a polymeric mesh material of manufacture for the second downstream layer and more specifically states a suitable polymeric mesh, such as, Naltex and Zicot. Both of these meshes/nettings are known in the art as an extruded mesh/net. See the Delstar website at www.deistarinc.com for information regarding Naltex and US Patent 5,725,784 column 7 lines 6-8 to Geibel et al regarding Zicot. Miller is silent to the extruded polymeric mesh having ribs. However, Pall ('881) teaches a pleated filter cartridge with upstream and downstream support members fabricated from extruded netting with ribs in column 3 lines 63-66 and column 4 lines 12-14. It is considered to have been obvious to one of ordinary skill in the art to fabricate the downstream support layer from an **extruded mesh/net** with ribs because an **extruded mesh/net** is a conventional material of manufacture for the downstream support layer and the ribs provide the support layer with reinforcement useful in pressurized filtration systems, such as, Miller and Pall's. (Emphasis added)

14. As to claim 14, Miller ('743) also describes the first downstream support layer is fabricated from a nonwoven material in column 3 lines 61-63, which meet's applicant's claim.

15. As to claim 16, Miller ('743) states said nonwoven material is fabricated as a wetlaid material in column 2 line 17, which meet's applicant's claim.

16. As to claim 17, Miller ('743) also states said nonwoven material is fabricated from polyester in column 4 line 24, which meet's applicant's claim.

17. As to claim 20, Miller (743) discloses in Figure 1 a perforated cage (11) is equipped with end caps (13,14) at both ends thereof, which meet's applicant's claim.

18. As to claim 21, Miller (743) discloses in Figure 1 said perforated core (12) is a cylindrical core and is coaxially positioned within the filter element, which is a cylindrical filter element, and the cage (11) is likewise cylindrical and is coaxially positioned about the cylindrical filter element, which meet's applicant's claim.

19. As to claim 22, Miller (743) also teaches a filter cartridge comprising a filter element (10) having a longitudinal axis, an outer periphery and an inner periphery, and including a filtration media (22), an upstream filter pleat support (21) positioned upstream from and in contact with said filtration media (22); and a multi-layer downstream support (23,24) positioned downstream from said filtration media (22), said multi-layer downstream support (23,24) including a first downstream support layer (23) and a second downstream support layer (24), wherein the first downstream support layer (23) is in contact with said filtration media (22) and is interposed between said filtration media (22) and said second downstream layer (24), said first downstream support layer (23) being fabricated so as to minimize points of surface contact with said filtration media (22). The second downstream support layer (24) is in contact with said first downstream support

layer (23) and is fabricated so as to facilitate lateral fluid flow relative to said multi-layer downstream filter pleat support (23,24); a perforated cage (11) surrounding the outer periphery of the filter element; a perforated core (12) surrounded by the inner periphery of the filter element; and end caps (13,14) enclosing both ends of the perforated cage (11). Miller further teaches a polymeric mesh material of manufacture for the second downstream layer and more specifically states a suitable polymeric mesh, such as, Naltex and Zicot. Both of these meshes/nettings are known in the art as an extruded mesh/net. See the Delstar website at www.deistarinc.com for information regarding Naltex and US Patent 5,725,784 column 7 lines 6-8 to Geibel et al regarding Zicot. Miller is silent to the extruded polymeric mesh having ribs. However, Pall ('881) teaches a pleated filter cartridge with upstream and downstream support members fabricated from extruded netting with ribs in column 3 lines 63-66 and column 4 lines 12-14. It is considered to have been obvious to one of ordinary skill in the art to fabricate the downstream support layer from an **extruded mesh/net** with ribs because an **extruded mesh/net** is a conventional material of manufacture for the downstream support layer and the ribs provide the support layer with reinforcement useful in pressurized filtration systems, such as, Miller and Pall's. (Emphasis added)

20. Claim 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over Miller et al (U.S. Patent No. 5,275,743) in view of Bayerlein et al. (U.S. Patent No. 6, 153,098), as stated in the paper mailed 3 November 2004.

21. Claims 8 and 15 are rejected under 35 U.S.C. 1 03(a) as being unpatentable over Miller et al (U.S. Patent No. 5,275,743), as stated in the paper mailed 3 November 2004.

22. Claim 11 is rejected under 35 U.S.C. 103(a) as being unpatentable over Miller et al (U.S. Patent No. 5,275,743) in view of Pall (U.S. Patent No. 4,033,881), as stated in the paper mailed 3 November 2004.

After receiving the final rejection, Appellant and Appellant's attorney conducted an Examiner interview. During the interview, Appellant made a concerted effort to clarify the distinguishing features of the independent claims of the present application. During the and after the interview, Appellant believed that the presentations clearly distinguished the claims of the present application from the any disclosure, suggestion or teaching contained in the applied references and asked the Examiner to reconsider the 35 U.S.C. § 103 rejections.

After the interview, Appellant strongly believed that the Examiner had received a preponderance of evidence to indicate beyond any reasonable doubt that a person skilled in the art would not have found Appellant's pending claims to be obvious, including a copy of the NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL PRELIMINARY EXAMINATION REPORT for the corresponding PCT application indicating that the nearly identical claims had

been found to be novel and have an inventive step. Accordingly, Appellant was surprised to receive the Advisory Action of June 27, 2005, from the Examiner indicating that the request for reconsideration has been considered but does not place the application in condition for allowance because:

1. The Examiner has reviewed the file and applicant's arguments and maintains that the Miller reference teaches an extruded netting and Miller in view of Pall teaches an extruded apertured film, wherein Pall discloses (column 4, lines 33-37) his extruded netting as an extruded film that is later punched to produce an apertured film.

2. It is unclear how applicant's claimed "extruded apertruded film" and preferred material of manufacture for the second downstream support Delstar Delnet differs structurally from Miller in view of Pall's extruded apertured film.

and that the proposed amendment would be entered into the record for consideration upon appeal.

Thus, the single substantive issue upon appeal is whether or not claims 1-4, 6, 7, 9, 10, 12-14, 16, 17, and 20-22 are patentable under 35 U.S.C. § 103(a) over Miller et al (U.S. Patent No. 5,275,743) in view of Pall (U.S. Patent No. 4,033,881).

As the Examiner knows, the Examiner carries the burden under Section 103 to establish a *prima facie* case of obviousness, *In re Fine*, 837 F.2d 1071, 5 U.S.P.Q.2d 1596 (Fed. Cir. 1988), and must show that the references relied on teach or suggest all of the limitations of the claims. *In re Wilson*, 424 F.2d 1382, 1385 (C.C.P.A. 1970). "Obviousness cannot be established by combining the teachings of the prior art to produce the claimed invention, absent some teaching, suggestion or incentive supporting the combination." *Carella v. Starlight Archery*, 804 F.2d 135, 231 U.S.P.Q. 375 (Fed. Cir. 1986). There must be some explicit teaching or suggestion in the art to motivate one of ordinary skill to combine the references in the manner suggested. *See, Arkie Lures, Inc. v. Gene Larew Tackle, Inc.*, 119 F.3d 953, 957, 43 U.S.P.Q.2d 1294 (Fed. Cir. 1997). *Fromson v. Anitec Printing Plates, Inc.*, 132 F.3d 1437, 45 U.S.P.Q.2d 1269 (Fed. Cir. 1997).

In this instance, the Examiner cannot establish a *prima facie* case of obviousness and has admitted that the primary reference relied upon does not teach or suggest all of the limitations of the amended independent claims. Since the secondary references cannot make up for the deficiencies of the primary applied reference, Appellants submit that all remaining claims are

allowable. Specifically, there is considerable difference between the **extruded apertured film** with ***ribs*** as required by the present independent claims and the **extruded mesh/net** with ribs as recited in the Examiner rejection of the independent claims. Accordingly, the independent claims, and each of the claims depending respectively therefrom, are not rendered obvious by the combination of Miller et al. ("743) in view of any of the applied secondary references. Therefore, withdrawal of the rejection under 35 U.S.C. §103(a) is respectfully requested for the following reasons.

As is also known, CCPA and Federal Circuit case law provide the grounds for attacking an obviousness rejection for want of a prima facie showing. One such ground for attacking an obviousness rejection for want of a prima facie showing can be expressed as follows:

B. The Examiner Failed to Prove a *Prima Facie* Case of Obviousness

As the Examiner knows, the PTO recognizes in MPEP §2142:

> The legal concept of *prima facie* obviousness is a procedural tool of examination which applies broadly to all arts. It allocates who has the burden of going forward with production of evidence in each step of the examination process. The examiner bears the initial burden of factually supporting any *prima facie* conclusion of obviousness. *If the examiner does not produce a prima facie case, the applicant is under no obligation to submit evidence of nonobviousness...* The initial evaluation of *prima facie* obviousness thus relieves both the examiner and applicant from evaluating evidence beyond the prior art and the evidence in the specification as filed until the art has been shown to suggest the claimed invention.

As Judge Newman astutely observed, "the determination of whether a *prima facie* case of obviousness has been made is a critical decision that controls the evidentiary procedures and burdens before the PTO." *In re Geiger,* 815 F.2d 686, 690, 2 USPQ2d 1276, 1279 (Fed. Cir. 1987) (Newman, Circuit Judge, concurring).

The Examiner may reject a claim as obvious (albeit novel) over a single prior art reference on the ground that it would have allegedly been obvious to a person of ordinary skill in the art to change what the reference shows to that which is claimed. The change, it may be asserted, is a matter of standard design technique. More often, however, the PTO will assert obviousness on the basis of the combination of two or more prior art references, *e.g.,* asserting that the primary reference

teaches or shows most of that which is claimed and the secondary reference shows or suggests the element (s) or other teaching missing from the primary reference.

In either the single reference or plural references situation, "the examiner must step backward in time and into the shoes worn by the hypothetical 'person of ordinary skill in the art' when the invention was unknown and just before it was made." MPEP §2142. The examiner must put aside knowledge of the applicant's disclosure, refrain from using hindsight, and consider the subject matter claimed "as a whole." *Id.*

As stated above, there is considerable difference between the **extruded apertured film** with ***ribs*** as required by the present independent claims and the **extruded mesh/net** with ribs as recited in the Examiner rejection of the independent claims. Accordingly, the independent claims, and each of the claims depending respectively therefrom, are not rendered obvious by the combination of Miller et al. ("743) in view of any of the applied secondary references. As the Examiner knows, the CCPA and Federal Circuit case law provide grounds for attacking an obviousness rejection for want of a *prima facie* showing.

A. "There Must Be a Basis in the Art for Combining or Modifying References."

MPEP §2143.01 provides:

> The mere fact that references can be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination. *In re Mills;* 916 F.2d 680, 16 USPQ2d 1430 (Fed. Cir. 1990).

The Federal Circuit has several times expressly addressed the issue of how to evaluate an alleged case *of prima facie* obviousness to determine whether it has been properly made. Thus, *In re Geiger, supra,* stated, in holding that the PTO "failed to establish a *prima facie* case of obviousness":

> Obviousness cannot be established by combining the teachings of the prior art to produce the claimed invention, absent some teaching, suggestion or incentive supporting the combination. *ACS Hospital Systems, Inc. v. Montefiore Hospital,* 732 F.2d 1572, 1577, 221 USPQ 929, 933 (Fed. Cir. 1984).

Of course, application of §103 presumes the existence of differences between the subject matter claimed and the teachings of any particular prior art reference. Otherwise a rejection under §102 would have sufficed. Thus, the Examiner must propose some modification of a particular

reference or a combination thereof with another reference in order to arrive at the claimed invention. The Federal Circuit's assessment in *Geiger,* quoted above, is directed to the sufficiency of the teachings of a particular reference to justify a conclusion that any proposed modification or combination of references is what one of ordinary skill in the art would have found obvious to do at the time the invention was made. 815 F.2d at 688, 2 USPQ2d at 1278 (Fed. Cir. 1987).

The CCPA earlier expressly held that there must be some logical reason apparent from the evidence of record that would justify a combination or modification of references. *In re Regel,* 188 USPQ 132 (CCPA 1975). In determining whether one of ordinary skill in the art would find it obvious to modify or combine references, the teachings of the references taken with the knowledge that a worker in the art already possesses constitute the scope and content of the prior art that is referred to in the *Graham* decision. *Graham v. John Deere,* 383 US 1, 148 USPQ 459 (1966). Thus, the question raised under §103 is whether the prior art taken as a whole would suggest the claimed invention taken as a whole to one of ordinary skill in the art. Accordingly, even if all elements of a claim are disclosed in various prior art references, the claimed invention taken as a whole cannot be said to be obvious **without some reason** given in the prior art **why** one of ordinary skill **would have been prompted** to **combine** the teachings of the references to **arrive at the claimed invention**. *In re Regel, supra.*

Prima facie obviousness does exist when the prior art suggests or anticipates the benefits of modifying or combining references or when external factors, such as the changing state of the art, provide the motivation to one of ordinary skill in the art to make the modification or combination. However, where no reasonable intrinsic or extrinsic justification exists for the proposed combination or modification, *prima facie* obviousness will not have been established.

Thus, it is important for the practitioner to examine whether there is an intrinsic basis in the prior art or some extrinsic factor that would prompt one of ordinary skill in the art to combine the teachings of the references. If there is not, then the Examiner has not met the burden of establishing a *prima facie* case of obviousness, and it becomes a task of the practitioner to traverse the rejection by way of denying the existence of a *prima facie* case of obviousness.

For example, *In re Herschler,* 591 F.2d 693, 200 USPQ 711 (CCPA 1979), involved a method of enhancing the penetration of physiologically active steroidal agents into and across a membrane. The process claim involved mixing a steroidal agent with dimethyl sulfoxide (DMSO), a well known industrial solvent. The advantage of the method was the elimination of injections of

steroidal agents and the increased ability to administer localized, as opposed to systemic, doses of the agent.

The prior art disclosed that the DMSO, as well as other compounds, had been added to hair lotion containing a soluble oil. The prior art indicated also that steroids may be added to hair lotion. However, no relationship was suggested to exist in the prior art between DMSO and such steroids.

The prior art disclosed that DMSO was an effective solubilizing agent in pharmaceutical and dermatologic compositions, but the formulation of the aforementioned prior art hair lotion already resulted in a clear solution containing more solvent than anything else. Accordingly, there would have been no reason for one of ordinary skill in the art to add any additional solvent to the hair lotion in any amount large enough to enhance the penetration across a membrane as required by the claims. Accordingly, although the secondary references taught that DMSO was generally useful as a solvent, there was no teaching or suggestion that one should use DMSO, out of countless other solvents, as a solvent for use with steroids. The court ruled, therefore, that the prior art simply did not provide any impetus to do what the inventor had done. Accordingly, the Examiner's case of *prima facie* obviousness failed.

In *In re Jansson,* 609 F.2d 996, 203 USPQ 976 (CCPA 1979), the court found that the only suggestion for the claimed combination came from the applicant's own specification. The claimed method related to preventing form molds from warping upon being sprayed with a hard metal coating. This problem was solved in the past by using frames and backing plates for the die. The applicant, however, sprayed a die model with a readily fusible thin metal layer and placed a die pattern on top of the fusible metal layer. When separated, the fusible metal layer adhered to the pattern. The pattern was next sprayed with a hard metal coating and a die replica of heat-resistant plastic was placed atop the coated pattern.

What the prior art failed to show was any use of an easily fusible metal coating on a die pattern from which the actual die was made. Thus, the court, in reversing the rejection, required some reason or suggestion from the prior art references cited by the Examiner for why one of ordinary skill in the art would have been led to produce the claimed invention. In the absence of such reason or suggestion, the *prima facie* case of obviousness failed. Some motivation to make a change is required in order to establish *prima facie* obviousness. When the prior art itself provides no apparent reason for one of ordinary skill in the art to make a modification or to combine references, an argument clearly, properly exists that the claimed subject matter would not have been obvious.

The Federal Circuit has also repeatedly warned against using the applicant's disclosure as a blueprint to reconstruct the claimed invention out of isolated teachings in the prior art. See, *e.g., Grain Processing Corp. v. American Maize-Products,* 840 F.2d 902, 907, 5 USPQ2d 1788, 1792 (Fed. Cir. 1988).

More recently, the Federal Circuit reversed the Office's §103 rejection of claims in *In re Rouffet,* 149 F.3d 1350, 47 USPQ2d 1453 (Fed. Cir. 1998), because the board had "reversibly erred in determining that one of [ordinary] skill in the art would have been motivated to combine these references in a manner that rendered the claim invention [to have been] obvious." *Id.* at 1357. The court noted that to "prevent the use of hindsight based on the invention to defeat patentability of the invention, this court requires the examiner to show a motivation to combine the references that create the case of obviousness." The court set forth three possible sources for such motivation, namely "the nature of the problem to be solved, the teachings of the prior art, and the knowledge of persons of ordinary skill in the art." *Id.* According to the court, "the Board merely invoked the high level of skill in the field of art," *id.,* without explaining what specific understanding or technological principle within the knowledge of one of ordinary skill in the art would have suggested the combination. "If such a rote invocation could suffice to supply a motivation to combine, the more sophisticated scientific fields would rarely, if ever, experience a patentable technical advance." *Id.*

Appellants find no **basis in the art for combining or modifying the applied references** in that there is not even any mention whatsoever of the nesting that results from the not even mentioned second downstream support layer comprising **an extruded apertured film having ribs.** Since the Examiner has failed to make a prime facie case of obviousness, Appellants respectfully submit that the claims, as currently amended, are allowable and an opinion acknowledging same is respectfully requested fro the Board.

B. All Claim Limitations Must Be Considered, Especially When Missing From the Prior Art

When evaluating a claim for determining obviousness, all limitations of the claim must be evaluated. A case in point is *In re Fine,* 873 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988), where the court reversed an obviousness rejection because the examiner ignored a material, claimed, temperature limitation which was absent from the reference.

Another case in point is *In re Miller,* 418 F.2d 1392, 164 USPQ 46 (CCPA 1969), where the court held that printed indicia on a measuring cup, while not *per se* patentable subject matter, had to be considered in determining patentability, explaining as follows:

The fact that printed matter by itself is not patentable subject matter, because non-statutory, is no reason for ignoring it when the claim is directed to a combination. Here there is a new and unobvious functional relationship between a measuring receptacle, volumetric indicia thereon indicating volume in a certain ration to actual volume, and legend indicating the ration, and in our judgment the appealed claims properly define this relationship.

Thus, if printed matter is functionally related to the other elements of the invention, the printed matter must be considered in determining whether the claimed invention is nonobvious in view of the prior art.

In *Jones v. Hardy,* 727 F.2d 1524, 220 USPQ 1021 (Fed. Cir 1984), the Federal Circuit reversed a district court holding of invalidity of patents relating to the use of molded polystyrene sheets in the formation of concrete walls, for failure to consider the invention "as a whole." The basic error of the trial court was in judging the "idea" behind the invention. The Federal circuit held that:

The invention cannot be tested on the basis of whether the "idea" of using molded polystyrene is patentable. Under the patent statute, Title 35 U.S.C., "ideas" are not patentable; claimed structures and methods are. Reducing a claimed invention to an "idea," and then determining patentability of that "idea" is error. [citation omitted.] Analysis properly begins with the claims, for they measure and define the invention. 727 F.2d at 1527-27, 220 USPQ at 1024.

The district court in *Jones* had treated the structural differences between the claimed invention and the prior art as the invention itself. Rejecting this denigration of the claimed invention "as a whole," the Federal Circuit observed that:

The "difference" may have seemed slight (as has often been the case with some of history's great inventions, *e.g.,* the telephone) but it may also have been the key to success and advancement in the art resulting from the invention. Further, it is irrelevant in determining obviousness that all or all other aspects of the claim may have been well known in the art. *Id.* at 1528, 220 USPQ at 1024.

The Federal Circuit has continually cautioned against myopic focus on the obviousness of the difference between the claimed invention and the prior art rather than on the obviousness *vel non*

of the claimed invention as a whole relative to the prior art as §103 requires. See, *e.g., Hybritech Inc. v. Monoclonal Antibodies, Inc.* 802 F.2d 1367, 1383, 231 USPQ 81, 93 (Fed. Cir. 1986).

As the Board will note, Appellants have amended the independent claims in an effort to clarify the specific combination Appellants intend to be the subject thereof. Specifically, Appellants have clarified that the second downstream support layer is in contact with the first downstream support layer and is fabricated so as to facilitate lateral fluid flow relative to the multi-layer downstream pleat support, wherein the second downstream support layer comprises **an extruded apertured film having ribs**.. Such specific description is not believed to be disclosed, suggested or taught by any of the currently applied references.

Since the Examiner has failed to make a prime facie case of obviousness, Appellants respectfully submit that the claims, as currently amended, are allowable and an opinion acknowledging same is respectfully requested fro the Board.

MPEP §2143.01 provides:

> The mere fact that references <u>can</u> be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination. *In re Mills;* 916 F.2d 680, 16 USPQ2d 1430 (Fed. Cir. 1990).

The Federal Circuit has several times expressly addressed the issue of how to evaluate an alleged case *of prima facie* obviousness to determine whether it has been properly made. Thus, *In re Geiger, supra,* stated, in holding that the PTO "failed to establish a *prima facie* case of obviousness":

Obviousness cannot be established by combining the teachings of the prior art to produce the claimed invention, absent some teaching, suggestion or incentive supporting the combination. *ACS Hospital Systems, Inc. v. Montefiore Hospital,* 732 F.2d 1572, 1577, 221 USPQ 929, 933 (Fed. Cir. 1984).

Of course, application of §103 presumes the existence of differences between the subject matter claimed and the teachings of any particular prior art reference. Otherwise a rejection under §102 would have sufficed. Thus, the Examiner must propose some modification of a particular reference or a combination thereof with another reference in order to arrive at the claimed invention. The Federal Circuit's assessment in *Geiger,* quoted above, is directed to the sufficiency of the teachings of a particular reference to justify a conclusion that any proposed

modification or combination of references is what one of ordinary skill in the art would have found obvious to do at the time the invention was made. 815 F.2d at 688, 2 USPQ2d at 1278 (Fed. Cir. 1987).

The CCPA earlier expressly held that there must be some logical reason apparent from the evidence of record that would justify a combination or modification of references. *In re Regel,* 188 USPQ 132 (CCPA 1975). In determining whether one of ordinary skill in the art would find it obvious to modify or combine references, the teachings of the references taken with the knowledge that a worker in the art already possesses constitute the scope and content of the prior art that is referred to in the *Graham* decision. *Graham v. John Deere,* 383 US 1, 148 USPQ 459 (1966). Thus, the question raised under §103 is **whether the prior art taken as a whole** would **suggest** the **claimed invention taken as a whole** to one of **ordinary skill in the art.**

Accordingly, even if all elements of a claim are disclosed in various prior art references, the claimed invention taken as a whole cannot be said to be obvious **without some reason** given in the prior art **why** one of ordinary skill **would have been prompted** to **combine** the teachings of the references to **arrive at the claimed invention**. *In re Regel, supra.*

Since the Examiner has **not** expressly pointed out **how** the prior art suggests or anticipates the benefits of modifying or combining references or when external factors, such as the changing state of the art, provide the motivation to one of ordinary skill in the art to make the modification or combination as claimed, but has only made the unsupported assertion that " It is considered to have been obvious to one of ordinary skill in the art to fabricate the downstream support layer from an extruded mesh/net with ribs because an extruded mesh/net is a conventional material of manufacture for the downstream support layer and the ribs provide the support layer with reinforcement useful in pressurized filtration systems, such as, Miller and Pall's.", Appellants respectfully summit that the Examiner has not made a case for *prima facie* obviousness and an action acknowledging same is respectively requested.

In the absence of such reason or suggestion, the *prima facie* case of obviousness failed. Some motivation to make a change is required in order to establish *prima facie* obviousness. When the prior art itself provides no apparent reason for one of ordinary skill in the art to make a modification or to combine references, an argument clearly, properly exists that the claimed subject matter would not have been obvious.

The Federal Circuit has also repeatedly warned against using the applicant's disclosure as a blueprint to reconstruct the claimed invention out of isolated teachings in the prior art. See, *e.g.,*

Grain Processing Corp. v. American Maize-Products, 840 F.2d 902, 907, 5 USPQ2d 1788, 1792 (Fed. Cir. 1988).

More recently, the Federal Circuit reversed the Office's §103 rejection of claims in *In re Rouffet,* 149 F.3d 1350, 47 USPQ2d 1453 (Fed. Cir. 1998), because the board had "reversibly erred in determining that one of [ordinary] skill in the art would have been motivated to combine these references in a manner that rendered the claim invention [to have been] obvious." *Id.* at 1357. The court noted that to "prevent the use of hindsight based on the invention to defeat patentability of the invention, this court requires the examiner to show a motivation to combine the references that create the case of obviousness." The court set forth three possible sources for such motivation, namely "the nature of the problem to be solved, the teachings of the prior art, and the knowledge of persons of ordinary skill in the art." *Id.* According to the court, "the Board merely invoked the high level of skill in the field of art," *id.,* without explaining **what specific understanding or technological principle within the knowledge of one of ordinary skill in the art would have suggested the combination**. "If such a rote invocation could suffice to supply a motivation to combine, the more sophisticated scientific fields would rarely, if ever, experience a patentable technical advance." *Id.*

In this particular rejection, the Examiner has not presented any such motivation or explained **what specific understanding or technological principle within the knowledge of one of ordinary skill in the art would have suggested the combination** and therefore has failed to present a prima facia case of obviousness and an action acknowledging same is respectfully requested. Specifically, there is considerable difference between the **extruded apertured film** with ***ribs*** as required by the present independent claims and the **extruded mesh/net** with ribs as recited in the Examiner rejection of the independent claims and an opinion acknowledging same is respectfully requested.

C. "Reliance Upon General Knowledge to Negate Patentability Must be Articulated and Placed on the Record and the Failure to do so is NOT Consistent with either Effective Administrative Procedure or Effective Judicial Review"

Concerning the Examiner's assertion (personal knowledge/official notice/design choice) without providing acceptable reasoning that certain claims are rejected because "it would have been obvious...," Appellants respectively submits that the Examiner's characterization of " It is considered to have been obvious to one of ordinary skill in the art to fabricate the downstream support layer from an extruded mesh/net with ribs because an extruded mesh/net is a conventional material of manufacture for the downstream support layer and the ribs provide the

support layer with reinforcement useful in pressurized filtration systems, such as, Miller and Pall's." is clearly **unsupported conclusions** (personal knowledge/official notice/design choice) - **not reasons** on which to **base rejections**. In fact, Appellants, who are skilled in the art, do not understand how the Examiner can possibly propose that the references cited could possibly disclose, suggest or teach the filter element, comprising, among other features, a second downstream support layer is in contact with the first downstream support layer and is fabricated so as to facilitate lateral fluid flow relative to the multi-layer downstream pleat support, wherein the second downstream support layer comprises **an extruded apertured film** having ***ribs***, as defined in the instant claims.

It is Appellants' position that the Examiner has not and cannot provide acceptable reasoning why the specific combination of features to form a filter element as required by the claims, would have been obvious to one of ordinary skill in the art.

One form of personal knowledge (other than the taking of official notice) is when the Examiner states that specific information that is needed to support the obviousness rejection is a matter of "design choice." That is, the Examiner is missing specific information and relies on general knowledge in the prior art that the Examiner assumes would teach the missing subject matter. The Examiner must provide sufficient reasoning to substantiate the claim of obvious design choice.

In the final rejection, the Examiner appears to make a new rejection based on "design choice," as the Board may know, a bald statement very similar to the Examiner's was addressed by the PTO Board of Patent Appeals and Interferences in In re Garrett, 33 BNA Pat. Trademark & Copyright J. 43 (November 13, 1986). The Board, in reversing an Examiner's similar, but legally untenable alleged rejection, held that the Examiner's assertion that the modification proposed was ..."an obvious matter of engineering design choice was an unsupported conclusion -- not a reason upon which to base the rejection". [See also In re Antonie, 559 F.2d 618, 195 U.S.P.Q. 6 (C.C.P.A. 1977), Carl Schenck, A.G. - v. Norton Corp., 713 F.2d 782, 218 U.S.P.Q. 698 (Fed. Cir. 1983) and Carman Industries v. Wahl, 774 F.2d 932, 220 U.S.P.Q. 481 (Fed. Cir. 1983)]. The Appellants find no disclosure, suggestion or teaching in the applied reference which would suggest to one skilled in the relevant art to combine the specific components mentioned above, as claimed in the present application. In fact, the only possible mention of an "apertured" anything is the reference to "perforated sheets or plates or woven of nonwoven or extruded **netting**...." and "**Nettings** also at formed of extruded thermoplastic resin sheet, which is embossed during or after extrusion and then stretched to open holes in the embossed areas, resulting in the formation of **netting** in sheet form." Clearly there is no disclosure, suggestion or teaching concerning a

combination as claimed using an **extruded apertured film having ribs** as the second downstream support layer in contact with the first downstream support layer and is fabricated so as to facilitate lateral fluid flow relative to the multi-layer downstream pleat support.

In a later example relating to "design choice", in In re Chu, 66 F.3d 292, 36 U.S.P.Q.2d 1089 (Fed. Cir. 1995), the invention related to an apparatus used to control or filter emissions, such as sulphur oxides, oxides of nitrogen, and particulates (such as fly ash), from fossil fuel boilers. The Examiner was of the opinion that the prior art showed all the features of the invention with the exception of a baghouse filter having a catalyst located within the filter. The applicant Chu argued that the prior art references did not teach or suggest the positioning of the catalyst inside the bag retainer of the filter bags. Chu maintained that this feature was significant because the bag retainer provided support and prevented the filter bags from collapsing during pulse-jet cleaning. Chu provided technical evidence relating to, for example, the frailty of fabric filters during pulse-jet cleaning, and the violent "snapping" action during pulse-jet cleaning.

On appeal, the Board concluded that situating the catalyst within the bag retainer was a matter of "design choice" and affirmed the rejection. The Federal Circuit, however, reversed the rejection. The court emphasized that Chu's technical evidence militated against a conclusion that placement of the catalyst was merely a design choice. **Since the Board provided no specific reasoning to support the assertion of design choice**, the Federal Circuit reversed the rejection. (Emphasis added) Thus, the Chu decision instructs that the Examiner **must provide reasoning why a specific feature is a matter of design choice,** and **therefore obvious**. (Emphasis added)

In a more recent case, In re Sang-Su Lee, 61 U.S.P.Q.2d 1430, the Federal Circuit spoke definitively concerning the requirement for "judicial review of a decision of the Board of Patent Appeals and Interferences denying an application for a patent by stating that any rejection must be founded on the obligation of the agency to make the necessary findings and to provide an administrative record showing the evidence on which the findings are based, accompanied by the agency's **reasoning** in reaching its conclusions." The Federal Circuit stated that "as applied to the determination of patentability vel non when the issue is obviousness, it is fundamental that the rejection of a patent application must be based on evidence comprehended by the language of the statute addressing obviousness." The Federal Circuit went on to say that "the patent examination process centers on prior art and the analysis thereof; when patentability turns on the question of obviousness, the search for an analysis of prior art includes evidence relevant to the findings of whether there is a teaching, motivation or suggestion to select and combine the references relied on as evidence of obviousness." The Federal Circuit further stated that "in an obviousness determination, the factual question of motivation to combine prior art is material to

patentability, and cannot be resolved on **subjective belief and unknown authority**." (Emphasis added) "In an obvious determination under patent law, it is improper, in determining whether a person of ordinary skill would have been led to combine references, simply to use that which the inventor taught against its teacher; thus, the Board of Patent Appeals and Interferences must not only assure that the requisite findings are made, based on evidence of the record, but must also explain the reasoning by which the findings are deemed to support the agency's conclusion."

As further stated in the opinion, "In finding the relevant facts, in assessing the significance of the prior art, and in making the ultimate determination of the issue of obviousness, the examiner and the Board of Patent Appeals and Interferences are presumed to act from the viewpoint of a person having ordinary skill in the art to which the subject matter pertain; thus, when they rely on what they assert to be general knowledge to negate patentability, that **knowledge must be articulated** and **placed on the record** and **the failure** to do so **is not consistent** with either effective **administrative procedure** or **effective judicial review**.... "In the context of an obvious determination, the Board of Patent Appeals and Interferences **cannot** rely on **conclusory statements** when dealing with particular combinations of prior art and specific claims, but must set forth the rationale on which it relies...." "Sound administrative procedure requires that an agency apply the law in accordance with statute and precedent; the agency tribunal must make findings of relevant facts, and present its reasoning in sufficient detail that the court may conduct meaningful review of the agency's action."

Specifically, the Federal Circuit stated as follows "...The foundation of the principal of judicial deference to the rulings of agency tribunals is that the tribunal has specialized knowledge and expertise, such that when reasoned findings are made, a reviewing court may confidently defer to the agency's application of its knowledge in its area of expertise. Reasoned findings are critical to the performance of agency functions and judicial reliance on agency competence." (Citations omitted) "The 'common knowledge and common sense' on which the Board relied in rejecting Lee's application are not the specialized knowledge and expertise contemplated by the Administrative Procedure Act. Conclusory statements such as those here provided do not fulfil the agency's obligation. This court explained in *Zurko*, 258 F.3d at 1385, 59 USPQ2d at 1697, that 'deficiencies of the cited references cannot be remedied by the Board's general conclusion about what is 'basic knowledge' or 'common sense.' The Board's finding must extend to all material facts and must be documented on the record, least the 'haze of so-called expertise' acquire insulation from accountability. 'Common knowledge and common sense,' even if assumed to be derived from the agency's expertise, do not substitute for authority when the law requires authority. (Citations omitted)

Appellants respectfully submit that, like the Board in In re Lee, by essentially saying that to combine the elements of the references, without a detailed explanation as to why or how, was 'common knowledge and common sense' and that such **is not** a substitute for **authority** when the **law requires authority**. Consequently, Appellants respectfully request that the Examiner provide the authority in the form of the above requested affidavit or additional reference/detailed explanation which provide the detailed explanation as to how the **apertured film having *ribs*** missing element of the applied references was provided, as required by the amended claims, and a favorable action on appeal is respectfully requested.

It is Appellants' position that the Examiner has not and cannot provide acceptable reasoning why the specific combination, as now required by the amended claims, are obvious without some documented evidence, **what specific understanding or technological principle within the knowledge of one of ordinary skill in the art would have suggested the combination** to support the asserted "**obviousness**" and a favorable action on appeal is respectfully requested.

As is known, it is an incumbent upon the Examiner to present all the elements of a prima facia case of obviousness. Thus, the Examiner must explain why the prior art appeared to show the claimed subject matter and not simply the general aspects of the invention. Further, the Federal Circuit has added that when more than one reference or source of prior art is required in establishing the obviousness rejection "it is necessary to ascertain whether the prior art teachings would appear to be sufficient to one of ordinary skill in the art to suggest making the claim substitution or other modification." [*See,* In re: Lalu, 747 F.2d 703, 223 U.S.P.Q. 1257, 1258 (Fed. Cir. 1984)] Thus, it is not enough that the Examiner present references that contain the assorted features of the invention. The Examiner must also show **why** it would appear that the references would have been combined. [*See also,* In re: Fritch, 972 F.2d 1260, 23 U.S.P.Q.2d 1780, 1783 (Fed. Cir. 1992)] This the Examiner has not done and cannot do as it is believed that there is no disclosure, suggestion or teaching in either of the applied references to combine the applied reference to produce the now claimed filter element and a favorable action on appeal is respectfully requested.

At this point, Appellants believe that they have provided more than enough factual and legal reasons to sufficiently overcome any possible rejections the Examiner may propose with respect to the newly presented claims.

Specifically, as stated above and numerous times before, there is considerable difference between the **extruded apertured film** with ***ribs*** as required by the present independent claims

and the **extruded mesh/net** with ribs as recited in the Examiner rejection of the independent claims and an opinion acknowledging same is respectfully requested.

D. "COMBINATION OF OLD ELEMENTS."

As the Examiner surly knows another area of special interest in obviousness determinations is for inventions relating to a combination of old elements. The general rule relating to the obviousness of an invention that combines old elements is the same as that for inventions that include all new elements. That is, whether it would have been obvious to have combined the claimed elements based on the prior art.

In other words, when an invention is a new combination or arrangement of components, such as mechanical components in a mechanical device, the legal conclusion of obviousness requires that there be some suggestion, motivation, or teaching in the prior art whereby the person of ordinary skill would have selected the components that the inventor selected and used them to make the new device. [Heidelberger Druckmaschinen AG vs Hantscho Commercial Prods., Inc., 21 F.3d 1068, 1072, 30 USPQ 2d 1377, 1379 (Fed. Cir. 1993) ("When the patented invention is made by combining known components to achieve a new system, the prior art must provide a suggestion or motivation to make such a combination."); Northern Telecom, Inc. v. Datapoint Corp., 908 F.2d 931, 934, 15 USPQ 2d 1321, 1323 (Fed. Cir. 1990) (it is insufficient that prior art shows similar components, unless it also contains some teaching, suggestion, or incentive for arriving at the claimed structure)].

"[V]irtually all [inventions] are combinations of old elements." [Richdel, Inc. v. Sunspool Corp., 714 F.2d 1573, 1579-80, 219 USPQ 8, 12 (Fed. Cir. 1983) ("Most, if not all, inventions are combinations and mostly of old elements."); Environmental Designs, Ltd. v. Union Oil Co., 713 F.2d 693, 698, 218 USPQ 865, 870 (Fed. Cir. 1983)].

The Federal Circuit has explained:

> Combination claims can consist of new combinations of old elements or combinations of new and old elements.... Because old elements are part of these combination claims, claim limitations may, and often do, read on the prior art.... It is well established in patent law that a claim may consist of all old elements, such as the rigid-conduit system, for it may be that the combination of the old elements is novel and patentable. Similarly, it is well established that a claim may consist of all old elements and one new element, thereby being patentable. [Clearstream Wastewater Sys., Inc. v. Hydro-Action, Inc., 206 F.3d 1440, 54 USPQ 2d 1185 (Fed. Cir. 2000) (citing Intel Corp. v. U.S. Int'l Trade Comm'n, 946 F.2d 821, 842, 20 USPQ

> 2d 1161, 1179 (Fed. Cir. 1991); Panduit Corp. v. Dennison Mfg., 810 F.2d 1561, 1575, 1 USPQ 2d 1593, 1603 (Fed. Cir. 1987))].

In addition, the Federal Circuit has stated:

> Most if not all inventions arise from a combination of old elements.... Thus, every element of a claimed invention may often be found in the prior art.... However, identification in the prior art of each individual part claimed is insufficient to defeat patentability of the whole claimed invention.... Rather, to establish obviousness based on a combination of the elements disclosed in the prior art, there must be some motivation, suggestion or teaching of the desirability of making the specific combination that was made by the applicant. [*In re* Kotzab, 217 F.3d 1365, 55 USPQ 2d 1313, 1317 (Fed. Cir. 2000)].

Therefore, an examiner may often find every element of a claimed invention in the prior art. If identification of each claimed element in the prior art were sufficient to negate patentability, very few patents would ever issue. [*In re* Rouffet, 47 USPQ 2d at 1457-58]. Furthermore, rejecting patents solely by finding prior art corollaries for the claimed elements would permit an examiner to use the claimed invention itself as a blueprint for piecing together elements in the prior art to defeat the patentability of the claimed invention. Such an approach would be "an illogical and inappropriate process by which to determine patentability." [Sensonics, Inc. v. Aersonic Corp., 81 F.3d 1566, 1570, 38 USPQ 2d 1551, 1554 (Fed. Cir. 1996)].

Accordingly:

> To prevent the use of hindsight based on the invention to defeat patentability of the invention, this court requires the examiner to show a motivation to combine the references that create the case of obviousness. In other words, the examiner must show reasons that the skilled artisan, confronted with the same problems as the inventor and with no knowledge of the claimed invention, would select the elements from the cited prior art references for combination in the manner claimed. In Re Rouffet, 47 USPQ 2d at 1457-58.

An example of an invention relating to a combination of old elements or process steps was given in *Fromson v. Advance Offset Plate, Inc.* [Fromson v. Advance Offset Plate, Inc., 755 F.2d 1549, 225 USPQ 26 (Fed. Cir. 1985)]. In *Fromson*, the claimed invention related to a photographic plate used in printing and for a process of manufacturing the plate. The patentee, Fromson, sued Advance Offset for infringing its patent. The district court held the process claims obvious over the prior art, and therefore invalid.

On appeal, the Federal Circuit reversed. Significant in the Federal Circuit's reversal was the district court's focus on the fact that the claimed process was **a combination of old steps**. As stated by the Federal Circuit:

> That each "element" was old at the time the invention was made was undisputed in the PTO, at trial, and before this court. There is no basis in the law, however, for treating combinations of old elements differently in determining patentability. See Stratoflex, Inc. v. Aeroquip Corp., 713 F.2d at 1540, 218 USPQ at 880.
> The critical inquiry is whether "there is something in the prior art as a whole to suggest the desirability, and thus the obviousness, of making the combination." Lindermann Maschinenfabrik GmbH v. American Hoist & Derrick Co., 730 F.2d at 1462, 221 USPQ at 488 (emphasis added). *Id.*, 225 USPQ at 31 (footnote omitted) (alteration in original).
>
> Because the District Court was unable to show any suggestion to combine the prior art elements, the Federal Circuit held the claimed invention nonobvious over the prior art. *Id.* at 32.

Thus, even if the Examiner's proposed combination of references were operable in the intended environment, Applicants respectfully submit that the present claims are patentable in view of the foregoing and an action acknowledging same is respectfully requested.

Specifically, as stated above and numerous times before, there is considerable difference between the **extruded apertured film** with ***ribs*** as required by the present independent claims and the **extruded mesh/net** with ribs as recited in the Examiner rejection of the independent claims and an opinion acknowledging same is respectfully requested.

E. The European Patent Office Has Granted a European Patent Containing Substantially the Same, if not the Identical Independent Claims as Presenting Pending Before the Board

As effectively argued at the European Patent Office, the following was presented to the Examiner in the present appealed application.

> A further distinction between the apertured film and the extruded mesh is the greater ability of the apertured film to "**nest**" when folded. When a material containing a 3-dimensional structure is folded onto itself, and when measured produces a thickness less than the sum of the 2 layers measured independently, then a "**nesting**" condition of the strands or ribs is taking place. The apertured film exhibits the greatest ability for the strands or ribs to "**nest**" due to the primary strand or rib formation running in the machine direction. This rib nesting capability allows for the maximum surface

area in the filter's design. In contrast, the extruded mesh possesses a diagonal strand relative to the machine direction that, when folded in the machine direction, provides only limited "nesting" capability of the ribs.

To support the above discussion, material samples were measured for single layer thickness and folded thickness (ribs facing ribs) using a vernier caliper. Calculated % nesting was determined by the equation:

% Nesting = (2 × Single Layer Thickness – Folded Thickness) / 2 × Single Layer Thickness.

	Type	Measured Single Layer Thickness (in)	Calculated 2x Thickness (in)	Measured Folded Thickness (in)	Calculated % Nesting
Delnet RC0707-24P	Apertured Film	0.006	0.012	0.007	42%
Delnet RB0707-31P	Apertured Film	0.005	0.010	0.006	40%
Nalle N01716-90PP	Extruded Netting	0.018	0.036	0.030	17%
Nalle N01014-60PP	Extruded Netting	0.011	0.022	0.020	9%
Typar 3091L	Spunbond	0.005	0.010	0.010	0%
PTFE Membrane	Membrane	0.002	0.004	0.004	0%

Examples of the nesting capabilities of the various materials measured are shown in the table above. As can be seen, apertured film material achieves over double the percent nesting as compared to the extruded mesh material.

The European primary reference discloses that an *"**Extruded polymeric mesh** is generally preferable to other support and drainage materials, including woven and non-woven fibrous webs and polymeric netting, because it is so smooth..."* (See page 3, lines 39 – 40). However, claim 1 of the present application specifies *"extruded apertured film having ribs"*. Benefits of the apertured film are related to the importance of 'beads', 'strands', or 'ribs' **nesting** to maximise the filter area and thus optimise flow performance. The strands of the **apertured film**, when folded upon one and other, will buckle and "misalign" (i.e. not be exactly opposed) creating the **optimum nesting condition**. The nested ribs which are now in a "side-by-side" fully nested configuration provide an efficient fluid pathway.

In contrast, in both the European and the U. S. primary references, careful strand or bead alignment is required: *"Care should be taken in the alignment of the support and drainage layer within the corrugator to ensure that the beads oppose themselves..."* [European primary reference, European Patent Application No. 0 470 485 A2, (based upon U. S. Patent No. 5,552,048"), at page 5, lines 35 to 37)].

The use of an extruded mesh in either primary reference does not give the performance benefits as described in the present claims. The extruded mesh (European and U. S. primary references) and apertured film (present claims) have equivalent flux capacities; however the material thickness and "nesting capabilities of the two materials are not equivalent. The following tables demonstrate the fundamental problem with the extruded mesh material in that the amount of filter media is limited due to increased material thickness properties and decreased nesting capabilities, when used in a high area filter design, as disclosed in the present application.

The following table presents the calculated effects of varying the thickness and nesting properties of the apertured film versus the extruded mesh on the individual

pleat thickness of a typical cartridge construction. The pleat thickness without nesting effects can be determined by summing the thickness of the individual layers of material and multiplying by 2 to arrive at the individual folded pleat thickness (see the table, sixth column *"2 x Sum of Material Thickness"*). The pleat thickness with nesting effects can be determined by first multiplying the downstream drainage layer thickness by the appropriate nesting % and then summing the thickness of the individual layers of material and multiplying by 2 to arrive at the individual folded pleat thickness (see the table, eighth column *"Individual Pleat Thickness"*).
The following table presents the calculated effects of varying the thickness and nesting properties of the apertured film vs. the extruded mesh on the individual pleat thickness of a typical cartridge construction. The pleat thickness without nesting effects can be determined by summing the thickness of the individual layers of material and multiplying by 2 to arrive at the individual folded pleat thickness (reference column "2x Sum of Material Thickness"). The pleat thickness with nesting effects can be determined by first multiplying the downstream drainage layer thickness by the appropriate nesting % and then summing the thickness of the individual layers of material and multiplying by 2 to arrive at the individual folded pleat thickness (reference column "Individual Pleat Thickness").

Filter Media Pleat Design	Upstream Support Thickness (in)	Membrane Thickness (in)	Downstream Support Thickness (in)	Downstream Drainage Thickness (in)	2x Sum of Material Thickness (in)	% Nesting of Downstream Drainage	Individual Pleat Thickness
A	0.004	0.002	0.004	0.005	0.030	40%	0.026
B	0.004	0.002	0.004	0.018	0.056	17%	0.050
C	0.004	0.002	0.004	0.010	0.040	9%	0.038

Pleat Design A: Typar 3091L/PTFE Membrane/ Typar 3091L/ **Apertured Film (Delnet RB0707-31P)**
Pleat Design B: Typar 3091L/PTFE Membrane/ Typar 3091L/ **Extruded Mesh (Nalle N01716-90PP)**
Pleat Design C: Typar 3091L/PTFE Membrane/ Typar 3091L/ **Extruded Mesh (Nalle N01014-60PP)**

Filter design A, which utilizes the apertured film, provides significantly more nesting capability than the extruded mesh materials. **This additional nesting capability allows for a smaller individual pleat thickness, which provides for the greatest filter area in a cartridge**.
The amount of filter media that can be packaged into a 10 inch cartridge with a centre core of outer diameter 1.73 inches and an outer cage of inner diameter of 2.646 inches can be determined in the following manner.

Pleat Pack Length = Center Core Dia x 3.14 = (1.73" x 3.14) = 5.435"
Number of Pleats per Cartridge = Pleat Pack Length / Individual Pleat Thickness = (5.435"/0.026") = 209 pleats
Effective Media Length = 2x Pleat Height x Number of Pleats per Cartridge = (2 x 0.44" x 209) = 184"
Total Effective Filter Media (10" Cart) = Effective Media Width x Effective Media Length = 9.16" x 184" = 1685 sqin.
Total Effective Filter Media in Sq Ft = 1685 sqin / 144 = 11.7 sqft

The example above utilized the pleat design A which contains the apertured film. A similar calculation can be made utilizing the extruded nets of pleat design B and C.

The following table shows 10 inch cartridge areas for both apertured film and extruded mesh constructions.

Filter Media Pleat Design	Individual Pleat Thickness	Total Pleats per Cartridge	10" Cartridge Area (sqft)	10" Cartridge Flow (gpm/psid)
A	0.026	209	11.7	4.1
B	0.050	109	6.1	2.1
C	0.038	142	8.0	2.8

Predicted product flow rates can then be determined in the following manner:
10" Cartridge Flow = 10" Cartridge Area x Filter Media Flow = (11.7 sqft x 0.35 gpm/psid/sqft) = 4.1 gpm/psid

The predicted results demonstrate the improved flow performance benefits expected of a filter design using an **apertured film** when compared to the extruded mesh.

The predicted results demonstrate the substantially improved flow performance benefits expected of a filter design using an apertured film when compared to the extruded mesh design of the prior art.

The expression 'apertured element' in claims 1 and 11 has been replaced with 'apertured film' to conform to the description, e.g. at page 11, line 9.

For the Examiner's review, applicants have attached hereto copy of the NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL PRELIMINARY EXAMINATION REPORT for the corresponding PCT application. As the Examiner will note, according to the European Examiner at POINT V, "The closest prior art is **D1** (US Patent No. 5,552,048) which discloses an extruded mesh material for the downstream support layer 24 having grabs (See figure 3 and accompanying description). The subject matter of claim 1 is new over D1 by providing an **extruded apertured film** material having ribs. As demonstrated by the applicant with comparative experiments in his letter of 01.10 .2004 an **extruded apertured film** material having rips (sic ribs) gives a surprisingly greater ability to "nest" when folded than the extruded mesh material of D1. The advance each of the use of an extruded apertured film material having rips and conjunctions with the use of an extruded mesh material having rips as disclosed in the 1 is a higher number of pleats and thus a greater filtering surface for cartridge of the same dimension. Thus the subject matter of claim 1 and the dependent claims therefrom fulfill the requirements of Articles 33(2) and 33(3) PCT." Since there is no mention of "rips" in the application, it is apparent that the term rips is a misspelling and that the term "ribs" is intended by the INTERNATIONAL PRELIMINARY EXAMINATION REPORT. As the Examiner will note, the secondary applied reference, Pall (U.S. Patent No. 4,033,881), as applied in the present Office Action, is Reference D9 in the European Patent Office Notification of Transmittal of the International Preliminary Examination Report and appears to be considered as only background art by the European Examiner.

As should be abundantly clear, the European Patent Office does not have any of the clarity problems as expressed by the USPTO Examiners in their denial of the request for reconsideration stating that the response has been considered but does not place the application in condition for

allowance because: "...It is unclear how applicant's claimed "extruded apertruded film" and preferred material of manufacture for the second downstream support Delstar Delnet differs structurally from Miller in view of Pall's extruded apertured film."

As the Board will note, the US primary reference was not even considered relevant in Europe and it would appear that The European Patent Office understood that the material provided by Appellants clearly distinguished the appealed claims from the best prior art and a Board opinion acknowledging same is respectively requested.

VIII. CONCLUSION

The claims on appeal clearly recite a new combination of elements that have been determined to be novel and possess an inventive step by the European Patent Office and has been clearly shown to be patentable over all applied references as well as the best references available in that the claims on appeal are new over all references by providing an **extruded apertured film** material having ribs. As demonstrated by the Appellant with comparative experiments an **extruded apertured film** material having ribs gives a surprisingly greater ability to "nest" when folded than the extruded mesh material of the applied references.

For the reasons discussed above, the reasoning forming the basis of the Examiners Final Rejection are not in accordance with Federal Circuit precedents, is technically incorrect and the Examiner has clearly failed to prove a *prima facie* case, as numerous elements of a valid *prima facie* case were not met.

Accordingly, for the foregoing reasons, reversal of the Final Rejection of Claims 1-17 and 20-22 is believed to be warranted and such action is earnestly solicited.

Authorization is hereby given to charge deposit account no. 033879 for a two-month extension of time for filing this Appeal Brief and the fee for filing this Appeal Brief.

Respectfully submitted,

Date: 10/31/05

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APPENDIX A: CLAIMS INVOLVED IN THE APPEAL

1. (currently amended) A filter element, comprising:

a filtration media;

an upstream filtration media support positioned upstream from and in contact with the filtration media; and

a multi-layer downstream filtration media support positioned downstream from the filtration media, the multi-layer downstream support including a first downstream support layer and a second downstream support layer, wherein:

the first downstream support layer is in contact with the filtration media and is interposed between the filtration media and the second downstream layer, the first downstream support layer is fabricated so as to minimize points of surface contact with the filtration media; and

the second downstream support layer is in contact with the first downstream support layer and is fabricated so as to facilitate lateral fluid flow relative to the multi-layer downstream pleat support, wherein the second downstream support layer comprises an extruded apertured film having ribs.

2. (Original) A filter element as recited in Claim 1, wherein the filtration media is a pleated filtration media having a plurality of longitudinally extending pleats.

3. (Original) A filter element as recited in Claim 2, wherein the longitudinally extending pleats of said pleated filtration media are selected from the group consisting of radial pleats, w-pleats and spiral pleats.

4. (Original) A filter element as recited in Claim 1, wherein the filtration media is a microporous filtration membrane having a pore size of from about 0.1 microns to about 10 microns.

5. (Original) A filter element as recited in Claim 1, wherein the filtration media is fabricated from a material selected from the group consisting of Teflon, nylon, polyaramide, polyvinylidene difluoride, polyether sulfone and combinations thereof.

6. (Original) A filter element as recited in Claim 1, wherein the multi-layer downstream support consists of said first downstream support layer and said second downstream support layer.

7. (Original) A filter element as recited in Claim 1, wherein said first downstream support layer is fabricated from a nonwoven material.

8. (Original) A filter element as recited in Claim 7, wherein said nonwoven material is laminated to said filtration media.

9. (Original) A filter element as recited in Claim 7, wherein said nonwoven material is fabricated as a spunbond, spunlace, airlaid or wetlaid material.

10. (Original) A filter element as recited in Claim 7, wherein said nonwoven material is fabricated from polypropylene, polyester or polyamide.

11. (Original) A filter as recited in Claim 1, wherein said second downstream support layer is an extruded apertured element.

12. (currently amended) A filter element, comprising:

a filtration media;

an upstream pleat support positioned upstream from and in contact with the filtration media; and

a multi-layer downstream pleat support positioned downstream from the filtration media, the multi-layer downstream support including at least a first downstream support layer and a second downstream support layer, wherein:

the first downstream support layer is in contact with the filtration media and is interposed between the filtration media and the second downstream layer, the first downstream support layer is fabricated so as to minimize points of surface contact with the filtration media; and

the second downstream support layer is in contact with the first downstream support layer and is fabricated so as to facilitate lateral fluid flow relative to the multi-layer downstream pleat support, wherein the second downstream support layer comprises an extruded apertured film having ribs.

13. (currently amended) A filter cartridge comprising:

a filter element having a longitudinal axis, an outer periphery and an inner periphery, and including a filtration media; an upstream filter media support positioned upstream from and in contact with said filtration media; and a multi-layer downstream support positioned downstream from the filtration media, the multi-layer downstream support including a first downstream support layer and a second downstream support layer, wherein:

the first downstream support layer is in contact with the filtration media and is interposed between the filtration media and the second downstream layer, the first downstream support layer being fabricated so as to minimize points of surface contact with the filtration media; and

the second downstream support layer is in contact with the first downstream support layer and is fabricated so as to facilitate lateral fluid flow relative to the multi-layer downstream filter media support, wherein the second downstream support layer comprises an extruded apertured film having ribs;

a perforated cage surrounding the outer periphery of the filter element;

a perforated core surrounded by the inner periphery of the filter element; and

end caps enclosing both ends of the perforated cage.

14. (Original) A filter cartridge as recited in Claim 13, wherein said first downstream support layer is fabricated from a nonwoven material.

15. (Original) A filter cartridge as recited in Claim 14, wherein said nonwoven material is laminated to said filtration media.

16. (Original) A filter element as recited in Claim 14, wherein said nonwoven material is fabricated as a spunbond, spunlace, airlaid or wetlaid material.

17. (Original) A filter element as recited in Claim 14, wherein said nonwoven material is fabricated from polypropylene, polyester or polyamide.

18. (Cancelled) A filter element as recited in Claim 1, wherein said second downstream support layer is an extruded apertured element.

19. (Cancelled) A filter element as recited in Claim 1, wherein said second downstream support layer is an extruded apertured element having ribs formed on one side.

20. (Original) A filter cartridge as recited in Claim 13 wherein the perforated cage is equipped with end caps at both ends thereof.

21. (Original) A filter cartridge as recited in Claim 13 wherein said perforated core is a cylindrical core and is coaxially positioned within the filter element which is a cylindrical filter element and the cage is likewise cylindrical and is coaxially positioned about the cylindrical filter element.

22. (currently amended) A filter cartridge comprising:

a filter element having a longitudinal axis, an outer periphery and an inner periphery, and including a filtration media; and a multi-layer downstream pleat support positioned downstream from the filtration media, the multi-layer downstream support including a first downstream support layer and a second downstream support layer, wherein:

the first downstream support layer is in contact with the filtration media and is interposed between the filtration media and the second downstream layer, the first downstream support layer being fabricated so as to minimize points of surface contact with the filtration media; and

the second downstream support layer is in contact with the first downstream support layer and is fabricated so as to facilitate lateral fluid flow relative to the multi-layer downstream pleat support, wherein the second downstream support layer comprises an extruded apertured film having ribs;

a perforated cage surrounding the outer periphery of the filter element;

a perforated core surrounded by the inner periphery of the filter element; and

end caps enclosing both ends of the perforated cage.

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1 October 2004

Dear Sirs

European Patent Application
based on International Patent Application No. PCT/US2003/029987
Our Ref: CUNU/P31327EP

This is a response to the Written Opinion of the International Preliminary Examining Authority dated 8 June 2004.

We enclose a revised set of claims 1 to 13 on pages 20 to 23, together with supporting arguments to overcome the various objections raised by the examiner.

In the revised claims, existing independent claims 1, 12, 13 and 22 have been consolidated to a single independent claim corresponding to existing claim 1.

Reference numerals have been inserted throughout the claims.

The examiner has suggested that existing claim 1 is not distinguished from document D1. We submit that this is not correct for the following reasons.

As correctly pointed out by the examiner, claim 1 was amended under Article 19 PCT in order to delimit over document D1. Claim 1 as amended recites that the *"second downstream support layer (22) comprises an extruded apertured film having ribs"*.

By contrast, D1 discloses that the downstream support layer 24 comprises an extruded mesh material (page 3, line 30). D1 does not suggest the use of an apertured film.

Apertured films are fundamentally distinct from extruded mesh materials in both their design and the processes used to manufacture them. Apertured films typically contain primary strands or ribs that run in the down web machine

cont/....

direction while the extruded meshes contain primary ribs or strands that only run diagonal to the down web machine direction. Apertured films are manufactured using a process similar to that used to produce biaxial oriented films while extruded mesh is manufactured using a counter-rotating die technology that places the strands in two different planes.

A further distinction between the apertured film and the extruded mesh is the greater ability of the apertured film to "nest" when folded. When a material containing a 3-dimensional structure is folded onto itself, and when measured produces a thickness less than the sum of the 2 layers measured independently, then a "nesting" condition of the strands or ribs is taking place. The apertured film exhibits the greatest ability for the strands or ribs to "nest" due to the primary strand or rib formation running in the machine direction. This rib nesting capability allows for the maximum surface area in the filter's design. In contrast, the extruded mesh possesses a diagonal strand relative to the machine direction that, when folded in the machine direction, provides only limited "nesting" capability of the ribs.

To support this, material samples were measured for single layer thickness and folded thickness (ribs facing ribs) using a vernier caliper. Calculated % nesting was determined by the equation:

$$\%\ Nesting = (2 \times Single\ Layer\ Thickness - Folded\ Thickness) / 2 \times Single\ Layer\ Thickness.$$

Examples of the nesting capabilities of the various materials measured are shown as follows:

	Type	Measured Single Layer Thickness (in)	Calculated 2x Thickness (in)	Measured Folded Thickness (in)	Calculated % Nesting
Delnet RC0707-24P	Apertured Film	0.006	0.012	0.007	42%
Delnet RB0707-31P	Apertured Film	0.005	0.010	0.006	40%
Nalle N01716-90PP	Extruded Netting	0.018	0.036	0.030	17%
Nalle N01014-60PP	Extruded Netting	0.011	0.022	0.020	9%
Typar 3091L	Spunbond	0.005	0.010	0.010	0%
PTFE Membrane	Membrane	0.002	0.004	0.004	0%

D1 discloses that an *"Extruded polymeric mesh is generally preferable to other support and drainage materials, including woven and non-woven fibrous webs and polymeric netting, because it is so smooth..."* (see page 3, lines 39 – 40). However, claim 1 of the present application specifies *"an extruded apertured element having ribs"* and more preferably, in claim 11, an *"extruded apertured*

cont/....

element [having] ribs on one side". Benefits of the apertured film are related to the importance of 'beads', 'strands', or 'ribs' nesting to maximise the filter area and thus optimise flow performance. The strands of the apertured film, when folded upon one and other, will buckle and "misalign" (i.e. not be exactly opposed) creating the optimum nesting condition. The nested ribs which are now in a "side-by-side" fully nested configuration provide an efficient fluid pathway.

In contrast, in D1, careful strand or bead alignment is required: *"Care should be taken in the alignment of the support and drainage layer within the corrugator to ensure that the beads oppose themselves..."* (D1, page 5, lines 35 to 37).

The use of an extruded mesh in D1 does not give the performance benefits as described in the present invention. The extruded mesh (D1) and apertured film (present invention) have equivalent flux capacities; however the material thickness and "nesting capabilities of the two materials are not equivalent. The following tables demonstrate the fundamental problem with the extruded mesh material in that the amount of filter media is limited due to increased material thickness properties and decreased nesting capabilities, when used in a high area filter design as disclosed in the present application.

The following table presents the calculated effects of varying the thickness and nesting properties of the apertured film versus the extruded mesh on the individual pleat thickness of a typical cartridge construction. The pleat thickness without nesting effects can be determined by summing the thickness of the individual layers of material and multiplying by 2 to arrive at the individual folded pleat thickness (see the table, sixth column *"2 × Sum of Material Thickness"*). The pleat thickness with nesting effects can be determined by first multiplying the downstream drainage layer thickness by the appropriate nesting % and then summing the thickness of the individual layers of material and multiplying by 2 to arrive at the individual folded pleat thickness (see the table, eighth column *"Individual Pleat Thickness"*).

cont/....

Filter Media Pleat Design	Upstream Support Thickness (in)	Membrane Thickness (in)	Downstream Support Thickness (in)	Downstream Drainage Thickness (in)	2x Sum of Material Thickness (in)	% Nesting of Downstream Drainage	Individual Pleat Thickness
A	0.004	0.002	0.004	0.005	0.030	40%	0.026
B	0.004	0.002	0.004	0.018	0.056	17%	0.050
C	0.004	0.002	0.004	0.010	0.040	9%	0.038

Pleat Design A: Typar 3091L/PTFE Membrane/ Typar 3091L/ **Apertured Film (Delnet RB0707-31P)**
Pleat Design B: Typar 3091L/PTFE Membrane/ Typar 3091L/ **Extruded Mesh (Nalle N01716-90PP)**
Pleat Design C: Typar 3091L/PTFE Membrane/ Typar 3091L/ **Extruded Mesh (Nalle N01014-60PP)**

Filter design A, which utilizes the apertured film, provides significantly more nesting capability than the extruded mesh materials. This additional nesting capability allows for a smaller individual pleat thickness, which provides for the greatest filter area in a cartridge.

The amount of filter media that can be packaged into a 10 inch cartridge with a centre core of outer diameter 1.73 inches and an outer cage of inner diameter of 2.646 inches can be determined in the following manner.

Pleat Pack Length = Centre Core Dia x 3.14 = (1.73" x 3.14) = 5.435"
Number of Pleats per Cartridge = Pleat Pack Length / Individual Pleat Thickness = (5.435"/0.026") = 209 pleats
Effective Media Length = 2x Pleat Height x Number of Pleats per Cartridge = (2 x 0.44" x 209) = 184"
Total Effective Filter Media (10" Cart) = Effective Media Width x Effective Media Length = 9.16" x 184" = 1685 sqin.
Total Effective Filter Media in Sq Ft = 1685 sqin / 144 = 11.7 sqft

The example above utilized the pleat design A which contains the apertured film. A similar calculation can be made utilizing the extruded nets of pleat design B and C.
The following table shows 10 inch cartridge areas for both apertured film and extruded mesh constructions.

cont/....

European Patent Office
1 October 2004

Filter Media Pleat Design	Individual Pleat Thickness	Total Pleats per Cartridge	10" Cartridge Area (sqft)	10" Cartridge Flow (gpm/psid)
A	0.026	209	11.7	4.1
B	0.050	109	6.1	2.1
C	0.038	142	8.0	2.8

Predicted product flow rates can then be determined in the following manner:

10" Cartridge Flow = 10" Cartridge Area x Filter Media Flow = (11.7 sqft x 0.35 gpm/psid/sqft) = 4.1 gpm/psid

The predicted results demonstrate the substantially improved flow performance benefits expected of a filter design using an apertured film when compared to the extruded mesh design of D1.

The expression 'apertured element' in claims 1 and 11 has been replaced with 'apertured film' to conform with the description, e.g. at page 11, line 9.

Any amendment is not to be construed as abandonment of subject matter.

Yours faithfully
ERIC POTTER CLARKSON

Raymond J Charig jad

Enc: Revised claims 1 to 15 on pages 20 to 23

1. A filter element, comprising:

a filtration media;

an upstream filtration media support positioned upstream from and in contact with said filtration media; and

a multi-layer downstream filtration media support positioned downstream from said filtration media, said multi-layer downstream support including a first downstream support layer and a second downstream support layer, wherein:

(a) said first downstream support layer is in contact with said filtration media and is interposed between said filtration media and said second downstream layer, said first downstream support layer is fabricated so as to minimize points of surface contact with said filtration media; and

(b) said second downstream support layer is in contact with said first downstream support layer and is fabricated so as to facilitate lateral fluid flow relative to said multi-layer downstream pleat support, wherein said second downstream support layer comprises an extruded apertured ~~element~~ film having ribs.

2. A filter element as recited in Claim 1, wherein the filtration media is a pleated filtration media having a plurality of longitudinally extending pleats.

3. A filter element as recited in Claim 2, wherein the longitudinally extending pleats of said pleated filtration media are selected from the group consisting of radial pleats, w-pleats and spiral pleats.

4. A filter element as recited in Claim 1, wherein the filtration media is a microporous filtration membrane having a pore size of from about 0.1 microns to about 10 microns.

5. A filter element as recited in Claim 1, wherein the filtration media is fabricated from a material selected from the group consisting of Teflon, nylon, polyaramide, polyvinylidene difluoride, polyether sulfone and combinations thereof.

support consists of said first downstream support layer and said second downstream support layer.

7. A filter element as recited in Claim 1, wherein said first downstream support layer is fabricated from a nonwoven material.

8. A filter element as recited in Claim 7, wherein said nonwoven material is laminated to said filtration media.

9. A filter element as recited in Claim 7, wherein said nonwoven material is fabricated as a spunbond, spunlace, airlaid or wetlaid material.

10. A filter element as recited in Claim 7, wherein said nonwoven material is fabricated from polypropylene, polyester or polyamide.

11. A filter as recited in Claim 1, wherein said extruded apertured ~~element~~ film has ribs on one side.

12. A filter element, comprising:

a filtration media;

an upstream pleat support positioned upstream from and in contact with said filtration media; and

a multi-layer downstream pleat support positioned downstream from said filtration media, said multi-layer downstream support including a first downstream support layer and a second downstream support layer, wherein:

(a) said first downstream support layer is in contact with said filtration media and is interposed between said filtration media and said second downstream layer, said first downstream support layer is fabricated so as to minimize points of surface contact with said filtration media; and

(b) said second downstream support layer is in contact with said first downstream support layer and is fabricated so as to facilitate lateral fluid flow relative to

support layer comprises an extruded apertured element having ribs.

12. ~~[13]~~ A filter cartridge comprising:

according to any one of claims 1 to 11, the filter element (12)

a filter element having a longitudinal axis, an outer periphery and an inner periphery; and

~~and including a filtration media; an upstream filter media support positioned upstream from~~ and in contact with said filtration media; and a multi-layer downstream support positioned downstream from said filtration media, said multi-layer downstream support including a first downstream support layer and a second downstream support layer, wherein:

(a) the first downstream support layer is in contact with said filtration media and is interposed between said filtration media and said second downstream layer, said first downstream support layer being fabricated so as to minimize points of surface contact with said filtration media; and

(b) the second downstream support layer is in contact with said first downstream support layer and is fabricated so as to facilitate lateral fluid flow relative to said multi-layer downstream filter media support, wherein said second ~~downstream support layer comprises an extruded apertured element having ribs;~~

the filter cartridge (10) further including:

a perforated cage (30) surrounding the outer periphery of the filter element;

a perforated core (20) surrounded by the inner periphery of the filter element; and

end caps (40) enclosing both ends of the perforated cage.

14. A filter cartridge as recited in Claim 13, wherein said first downstream support layer is fabricated from a nonwoven material.

15. A filter cartridge as recited in Claim 14, wherein said nonwoven material is laminated to said filtration media.

16. A filter element as recited in Claim 14, wherein said nonwoven material is fabricated as a spunbond, spunlace, airlaid or wetlaid material.

17. A filter element as recited in Claim 14, wherein said nonwoven material is fabricated from polypropylene, polyester or polyamide.

support layer is an extruded apertured element having ribs.

19. A filter element as recited in Claim 13, wherein said second downstream support layer is an extruded apertured element having ribs formed on one side.

20. A filter cartridge as recited in Claim 13 wherein the perforated cage is equipped with end caps at both ends thereof.

13. ~~21~~ A filter cartridge as recited in Claim 12 wherein said perforated core (20) is a cylindrical core and is coaxially positioned within the filter element which is a cylindrical filter element and the cage (30) is likewise cylindrical and is coaxially positioned about the cylindrical filter element.

22. A filter cartridge comprising:

a filter element having a longitudinal axis, an outer periphery and an inner periphery, and including a filtration media; and a multi-layer downstream pleat support positioned downstream from said filtration media, said multi-layer downstream support including a first downstream support layer and a second downstream support layer, wherein:

(a) the first downstream support layer is in contact with said filtration media and is interposed between said filtration media and said second downstream layer, said first downstream support layer being fabricated so as to minimize points of surface contact with said filtration media; and

(b) the second downstream support layer is in contact with said first downstream support layer and is fabricated so as to facilitate lateral fluid flow relative to said multi-layer downstream pleat support, wherein said second downstream support layer comprises an extruded apertured element having ribs;

a perforated cage surrounding the outer periphery of the filter element;

a perforated core surrounded by the inner periphery of the filter element; and

end caps enclosing both ends of the perforated cage.

PATENT COOPERATION TREATY

RECEIVED 10-14-04

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

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PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Rule 71.1)

Date of mailing *(day/month/year)*	14.10.2004

Applicant's or agent's file reference	IMPORTANT NOTIFICATION
xxx CUNO-639.1 PCT	

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US 03/29987	24.09.2003	26.09.2002

Applicant
CUNO INCORPORATED

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.

2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.

3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. **REMINDER**

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

The applicant's attention is drawn to Article 33(5), which provides that the criteria of novelty, inventive step and industrial applicability described in Article 33(2) to (4) merely serve the purposes of international preliminary examination and that "any Contracting State may apply additional or different criteria for the purposes of deciding whether, in that State, the claimed inventions is patentable or not" (see also Article 27(5)). Such additional criteria may relate, for example, to exemptions from patentability, requirements for enabling disclosure, clarity and support for the claims.

Name and mailing address of the international preliminary examining authority:	Authorized Officer
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PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference XXX	**FOR FURTHER ACTION**	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/US 03/29987	International filing date *(day/month/year)* 24.09.2003	Priority date *(day/month/year)* 26.09.2002
International Patent Classification (IPC) or both national classification and IPC B01D29/21		
Applicant CUNO INCORPORATED		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 4 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 4 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the opinion
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
19.04.2004	14.10.2004
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized Officer Hoffmann, A Telephone No. +49 89 2399-8610

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/US 03/29987

I. Basis of the report

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*:

Description, Pages

1-19 as originally filed

Claims, Numbers

1-13 received on 04.10.2004 with letter of 01.10.2004

Drawings, Sheets

1/2-2/2 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

   These elements were available or furnished to this Authority in the following language: , which is:

   ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).

   ☐ the language of publication of the international application (under Rule 48.3(b)).

   ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

   ☐ contained in the international application in written form.

   ☐ filed together with the international application in computer readable form.

   ☐ furnished subsequently to this Authority in written form.

   ☐ furnished subsequently to this Authority in computer readable form.

   ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

   ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

   ☐ the description, pages:

   ☐ the claims, Nos.:

   ☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

   (Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-13
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-13
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-13
	No:	Claims	

2. Citations and explanations

   see separate sheet

The following documents are cited in the Int. Search Report:

D1: EP-A-0 470 485 (PALL CORP) 12 February 1992 (1992-02-12)
D2: US-A-5 374 354 (VANDERZYDEN HENRY R ET AL) 20 December 1994 (1994-12-20)
D3: EP-A-0 048 310 (INCOM INT INC) 31 March 1982 (1982-03-31)
D4: US-A-4 012 211 (GOETZ GEORGE W) 15 March 1977 (1977-03-15)
D5: US-B-6 267 2521 (AMSLER NICOLE MICHELE) 31 July 2001 (2001-07-31)
D6: US-A-4 488 966 (SCHAEFFER JOHN I) 18 December 1984 (1984-12-18)
D7: US 2002/060183 A1 (PAUL C THOMAS ET AL) 23 May 2002 (2002-05-23)
D8: US-A-3 871 851 (NEUMANN GERHARD MAX) 18 March 1975 (1975-03-18)
D9: US-A-4 033 881 (PALL DAVID B) 5 July 1977 (1977-07-05)

POINT V:

The closest prior art is D1 which discloses an extruded mesh material for the downstream support layer 24 having rips (see figure 3 and accompanying description).

The subject matter of claim 1 is new over D1 by providing an extruded apertured film material having rips.

As demonstrated by the Applicant with comparative experiments in his letter of 01.10.2004 an extruded apertured film material having rips gives a surprising greater ability to "nest" when folded than the extruded mesh material of D1. The advantage of the use of an extruded apertured film material having rips in comparison with the use of an extruded mesh material having rips as disclosed in D1 is a higher number of pleats and thus a greater filtering surface for a cartridge of the same dimension.

Thus the subject matter of claim 1 and the dependent claims thereof fulfil the requirements of Articles 33(2) and 33 (3) PCT.

The description is not adapted to the new claims and D1 is not discussed therein.

1. A filter element (12), comprising:

a filtration media (18);

an upstream filtration media support (16) positioned upstream from and in contact with said filtration media; and

a multi-layer downstream filtration media support (13,22) positioned downstream from said filtration media, said multi-layer downstream support including a first downstream support layer (19) and a second downstream support layer (22), wherein:

(a) said first downstream support layer (19) is in contact with said filtration media (18) and is interposed between said filtration media and said second downstream layer (22), said first downstream support layer is fabricated so as to minimize points of surface contact with said filtration media; and

(b) said second downstream support layer (22) is in contact with said first downstream support layer and is fabricated so as to facilitate lateral fluid flow relative to said multi-layer downstream pleat support, wherein said second downstream support layer (22) comprises an extruded apertured ~~element~~ film having ribs.

2. A filter element as recited in Claim 1, wherein the filtration media (18) is a pleated filtration media having a plurality of longitudinally extending pleats (14).

3. A filter element as recited in Claim 2, wherein the longitudinally extending pleats (14) of said pleated filtration media (18) are selected from the group consisting of radial pleats, w-pleats and spiral pleats.

4. A filter element as recited in Claim 1, wherein the filtration media (18) is a microporous filtration membrane having a pore size of from about 0.1 microns to about 10 microns.

5. A filter element as recited in Claim 1, wherein the filtration media (18) is fabricated from a material selected from the group consisting of Teflon, nylon, polyaramide, polyvinylidene difluoride, polyether sulfone and combinations thereof.

support consists of said first downstream support layer and said second downstream support layer.

7. A filter element as recited in Claim 1, wherein said first downstream support layer is fabricated from a nonwoven material.

8. A filter element as recited in Claim 7, wherein said nonwoven material is laminated to said filtration media.

9. A filter element as recited in Claim 7, wherein said nonwoven material is fabricated as a spunbond, spunlace, airlaid or wetlaid material.

10. A filter element as recited in Claim 7, wherein said nonwoven material is fabricated from polypropylene, polyester or polyamide.

11. A filter as recited in Claim 1, wherein said extruded apertured ~~element~~ film has ribs on one side.

12. A filter element, comprising:

a filtration media;

an upstream pleat support positioned upstream from and in contact with said filtration media; and

a multi-layer downstream pleat support positioned downstream from said filtration media, said multi-layer downstream support including a first downstream support layer and a second downstream support layer, wherein:

(a) said first downstream support layer is in contact with said filtration media and is interposed between said filtration media and said second downstream layer, said first downstream support layer is fabricated so as to minimize points of surface contact with said filtration media; and

(b) said second downstream support layer is in contact with said first downstream support layer and is fabricated so as to facilitate lateral fluid flow relative to

support layer comprises an extruded apertured element having ribs.

12. ~~431~~ A filter cartridge comprising:

According to any one of claims 1 to 11, the filter element (12)

a filter element having a longitudinal axis, an outer periphery and an inner periphery; and

~~and including a filtration media; an upstream filter media support positioned upstream from~~ and in contact with said filtration media; and a multi-layer downstream support positioned downstream from said filtration media, said multi-layer downstream support including a first downstream support layer and a second downstream support layer, wherein:

(a) the first downstream support layer is in contact with said filtration media and is interposed between said filtration media and said second downstream layer, said first downstream support layer being fabricated so as to minimize points of surface contact with said filtration media; and

(b) the second downstream support layer is in contact with said first downstream support layer and is fabricated so as to facilitate lateral fluid flow relative to said multi-layer downstream filter media support, wherein said second ~~downstream support layer comprises an extruded apertured element having ribs;~~

the filter cartridge (10) further including:

a perforated cage (30) surrounding the outer periphery of the filter element;

a perforated core (20) surrounded by the inner periphery of the filter element; and

end caps (40) enclosing both ends of the perforated cage.

14. A filter cartridge as recited in Claim 13, wherein said first downstream support layer is fabricated from a nonwoven material.

15. A filter cartridge as recited in Claim 14, wherein said nonwoven material is laminated to said filtration media.

16. A filter element as recited in Claim 14, wherein said nonwoven material is fabricated as a spunbond, spunlace, airlaid or wetlaid material.

17. A filter element as recited in Claim 14, wherein said nonwoven material is fabricated from polypropylene, polyester or polyamide.

support layer is an extruded apertured element having ribs.

19. A filter element as recited in Claim 13, wherein said second downstream support layer is an extruded apertured element having ribs formed on one side.

20. A filter cartridge as recited in Claim 13 wherein the perforated cage is equipped with end caps at both ends thereof.

13. ~~21~~ A filter cartridge as recited in Claim ~~13~~ 12 wherein said perforated core (20) is a cylindrical core and is coaxially positioned within the filter element which is a cylindrical filter element and the cage (30) is likewise cylindrical and is coaxially positioned about the cylindrical filter element.

22. A filter cartridge comprising:

a filter element having a longitudinal axis, an outer periphery and an inner periphery, and including a filtration media; and a multi-layer downstream pleat support positioned downstream from said filtration media, said multi-layer downstream support including a first downstream support layer and a second downstream support layer, wherein:

(a) the first downstream support layer is in contact with said filtration media and is interposed between said filtration media and said second downstream layer, said first downstream support layer being fabricated so as to minimize points of surface contact with said filtration media; and

(b) the second downstream support layer is in contact with said first downstream support layer and is fabricated so as to facilitate lateral fluid flow relative to said multi-layer downstream pleat support, wherein said second downstream support layer comprises an extruded apertured element having ribs;

a perforated cage surrounding the outer periphery of the filter element;

a perforated core surrounded by the inner periphery of the filter element; and

end caps enclosing both ends of the perforated cage.

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Application No.	Ref.	Date
03 759 444.7 - 2113	CUNEU/P31327EP	06.09.2005
Applicant: Cuno Incorporated		

Communication under Rule 51(4) EPC

You are informed that the Examining Division intends to grant a European patent on the basis of the above application with the text and drawings as indicated below:

In the text for the Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LI LU MC NL PT RO SE SI SK TR

Description, Pages

2-4, 6-18	as published
1, 4a, 5, 19	received on 23.06.2005 with letter of 22.06.2005

Claims, Numbers

1-13	as annexed to the Int. Prel. Examination Report

Drawings, Sheets

1/2, 2/2	as published

With the following amendments to the above-mentioned documents by the examining division

Claims, Numbers 1

A copy of relevant documents is enclosed

The title of the invention in the three official languages of the European Patent Office, the international patent classification, the designated Contracting States, the registered name of the applicant and the bibliographic data are shown on the attached EPO Form 2056.

You are requested within a **non-extendable** period of four months of notification of this communication

1. to file 1 set of translations of the claim(s) in the two other EPO official languages;

		EUR
2a. to pay the fee for grant including the fee for printing up to and including 35 pages;	Reference 007	715.00
2b. to pay the printing fee for the 36th and each additional page; number of pages: 0	Reference 008	0.00
3. to pay the additional claim fee(s) (Rule 51(7) EPC); number of claims fees payable:	Reference 016	0.00
	Total amount	715.00

Concerning the possibility of a request for accelerated grant pursuant to Article 97(6) EPC, reference is made to OJ EPO 2001, 459.

If the grant, printing or claims fees are not paid, or the translations not filed, in due time the European patent application will be deemed to be withdrawn (Rule 51(8) EPC).

For all payments you are requested to use EPO Form 1010 or to refer to the relevant reference number.

After publication, the European patent specification can be downloaded free of charge from the EPO publication server https://publications.european-patent-office.org or ordered only from the Vienna sub-office upon payment of a fee (OJ EPO 2005, 126).

Upon request in writing each proprietor will receive the certificate for the European patent **together with one copy** of the patent specification only if the request is filed within the time limit of Rule 51(4) EPC. If such request has been previously filed, it has to be confirmed within the time limit of Rule 51(4) EPC. The requested copy is free of charge. If the request is filed after expiry of the Rule 51(4) EPC time limit, the certificate will be delivered without a copy of the patent specification.

Translation of the priority document(s)

If the translation of the priority document(s), as required by Article 88(1) EPC, or the declaration according to Rule 38(5) EPC has not yet been filed, Form 2530 will be despatched separately. The translation is to be filed within the above mentioned time limit (Rule 38(5) EPC).

Note on payment of renewal fees

If a renewal fee falls due between notification of the present communication and the proposed date of publication of the mention of the grant of the European patent, publication will be effected only after the renewal fee and any additional fee have been paid (Rule 51(9) EPC).

Under Article 86(4) EPC, renewal fees are payable to the European Patent Office until the year in which the mention of the grant of the European patent is published.

Filing of translations in the Contracting States

Pursuant to Article 65(1) EPC the following Contracting States require a translation of the specification of the European patent in their/one of their official language(s) (Rule 51(10) EPC), **insofar** this specification will not be published in their/one of their official language(s)

- within **three** months of publication of the mention of such decision:

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- within **six** months of publication of the mention of such decision:

IE IRELAND

The date on which the European Patent Bulletin publishes the mention of the grant of the European patent will be indicated in the decision on the grant of the European patent (EPO Form 2006).

The translation must be filed with the national Patent Offices of the Contracting or Extension States in accordance with the provisions applying thereto in the State concerned. Further details (e.g. appointment of a national representative or indication of an address for service within the country) are given in the EPO information brochure "National law relating to the EPC", and in the supplementary information published in the Official Journal of the EPO, or available on the EPO website.

Failure to supply such translation to the Contracting and Extension States in time and in accordance with the requirements may result in the patent being deemed to be void ab initio in the State concerned.

Note to users of the automatic debiting procedure

Unless the EPO receives prior instructions to the contrary, the fee(s) will be debited on the last day of the period of payment. For further details see the Arrangements for the automatic debiting procedure (see Supplement to OJ EPO 2, 2002).

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Enclosure(s): Form 2056
26 Copies of the relevant documents

ADDITIONAL SHEET +++ IMPORTANT INFORMATION +++

1. **For communications under Rule 51(4) EPC issued on or after 01.04.2005 the time limit of four months is not extendable anymore:**

   According to Rule 51(4) EPC as amended the time limit set in the communication under Rule 51(4) EPC will be four months in all applications without possibility of extension.

   Amended Rule 51(4) EPC applies to all applications for which a communication under Rule 51(4) EPC is issued on or after 01.04.2005.

2. **A copy of the patent specification will only be annexed to the European Patent certificate upon special request within the time limit of the 51(4) EPC communication:**

   Under Rule 54 EPC as amended and the decision of the President of the EPO dated 22.12.2004 (OJ EPO 2005, 122) each proprietor will receive the certificate for the European patent together with a copy of the patent specification upon request in writing and only if the request is filed within the time limit of Rule 51(4) EPC. If such request has been previously filed, it has to be confirmed within the time limit of Rule 51(4) EPC. The requested copy is free of charge.

   If the request is filed after expiry of the Rule 51(4) EPC time limit, the certificate will be delivered without a copy of the patent specification.

   After publication, the European patent specification can be downloaded free of charge from the EPO publication server https://publications.european-patent-office.org or ordered from the Vienna sub-office upon payment of a fee (OJ EPO 2005, 126).

   As before, upon payment of an administrative fee a duplicate copy of the European patent certificate with the patent specification attached or a certified copy of the patent specification will also be supplied.

Annex to EPO Form 2004, Communication under Rule 51(4) EPC

Bibliographical data of European patent application No. 03 759 444.7

For the intended grant of a European patent, the bibliographical data are set out below, for information:

Title of invention:
- EIN FILTERMEDIUM MIT MEHRSCHICHTIGER FALTENABSTÜTZUNG ENTHALTENDEM FILTERELEMENT
- FILTERELEMENT INCLUDING FILTRATION MEDIA WITH MULTI-LAYER PLEAT SUPPORT
- ELEMENT DE FILTRE COMPRENANT UN MILIEU DE FILTRATION ET UN SUPPORT PLISSE A COUCHES MULTIPLES

Classification: B01D29/21

Date of filing: 24.09.2003

Priority claimed: US /26.09.2002 /USP413990

Contracting States* for which fees have been paid: AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LI LU MC NL PT RO SE SI SK TR

Extension States* for which fees have been paid:

Applicant(s):**

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*) In case the time limits pursuant to Article 79(2) and Rule 85a EPC have not yet expired, **all Contracting States/Extension States** have been mentioned.

**) In case two or more applicants have designated different Contracting States, this is indicated here.

FILTERELEMENT INCLUDING FILTRATION MEDIA WITH MULTI-LAYER PLEAT SUPPORT

~~RELATED APPLICATION~~

~~The present application claims priority to U.S. Provisional Patent Application Serial No. 60/413,990 filed September 26, 2002, the disclosure of which is incorporated herein by reference.~~

BACKGROUND OF THE DISCLOSURE

1. Technical Field

The present disclosure relates to fluid filtration devices and, more particularly, to pleated filters having at least two downstream support layers, thereby enhancing filtration performance and improving flow/throughput.

2. Background of the Related Art

Filtration is the process of separating particles, or contaminants from a fluid (liquid or gas), and can be accomplished by passing the fluid through a porous filter medium that stops or captures the particles while permitting the fluid to pass there through. Such fluid filtering is used extensively in the manufacture of polymer products, medicinal products, mineral and metallurgical processing, petroleum refining water purification, emissions control, and in beverage and food preparation.

Over the years, the design of cylindrical pleated filter cartridges has involved efforts to maximize the amount of filter media or the available surface area that may be fit into a filter cartridge having a given outer diameter without adversely effecting flow or filter life. Pleated filter elements have flow rate and throughput limitations associated with the maximum amount of filter media that can be packaged into a pre-

defined filter envelope. Improvements in filter performance can be difficult due to large pre-established fairly standardized customer bases which utilize a common filter housing of design dimensions, and configuration within which the filter elements are enclosed accepting only one or more filter elements of a specific size. A major challenge of filter designers is to increase the filtering capacity of a filter element, i.e., the usable surface area without altering its external dimensions so that the filter element can be employed with existing filter housings.

One method for improving filter flow and throughput performance of pleated filter elements is to increase the amount of filtration media present in the filter. This can be accomplished by reducing the thickness of both the filtration media and the pleat support and drainage medium or materials. However, reducing the thickness of the filtration media potentially compromises retention properties of the filtration device, i.e., removal of particulates by sieving or trapping within the filtration media. Furthermore, the use of increasingly thinner supports can have a negative effect on flow and throughput performance by not providing sufficient flow paths.

Design efforts directed to optimizing filtration performance have yielded various pleat designs and pleat configurations aimed at increasing filtration area, e.g., through modified pleat geometries such as "spiral" or "multi-pleat" constructions. However, the use of spiral and multi-pleat designs typically requires utilization of a smaller core to realize the desired benefits. While a smaller core is not always a serious limitation for liquid applications, it is a serious limitation for gas applications where flow losses through a smaller core can be significant.

With reference to prior art pleat designs, in a standard radially pleated filter cartridge, such as that disclosed in U.S. Patent No. 3,692,184 to Miller, Jr. et al., the amount of filter media that may be packed into the cartridge is limited by the number of pleats that can be packed about the cartridge core. Consequently, there is a substantial amount of empty space between adjacent pleats at the outer periphery of the filter element. Accordingly, in a typical cylindrical pleated filter cartridge, there is a great deal of unused space between adjacent pleats as the distance from the center of the core

increases. Further, the pleats are highly compressed at the inner periphery which can impede flow due to support compression.

A cylindrical filter element having a radially extending W-pleat configuration, such as that disclosed in U.S. Patent No. 3,799,354 to Buckman et al., represents an alternative to a standard radially pleated filter element. The radial W-pleat configuration minimizes pleat spacing and provides added surface area about the outer periphery of the filter element by providing relatively short pleats that extend radially inward from the outer periphery of the filter between every two pleats of standard height. The short pleats are the same height and arise at a uniform frequency about the circumference of the filter, i.e., there is one short pleat between every two full length pleats. These shorter pleats occupy the open space near the outer periphery of the filter element, but do not maximize the amount of filter media that can be disposed within the cartridge, as some empty space still remains between the pleats. One problem associated with the W-pleat construction is a less than optimum pleat density. The radial W-pleat construction also suffers from the effect of pleat migration, in that the shortened pleats tend to move radially inward towards the central axis of the filter. This migration is undesirable as it can cause binding, blockages, increased pressure drops across the filter, reduced filter life and potential to the filter media.

U.S. Patent No. 4,033,881 to Pall discloses filter cartridges comprising a plurality of layer paper sheet filter sheets of different pore sizes that includes foraminous relatively rigid support and drainage members having greater rigidity than the paper filter media. According to the Pall '881 patent, "suitable foraminous external and internal supports can be made of metal or plastic, and can be, for example, in the form of perforated sheets or plates, or woven or nonwoven or extruded netting, made of plastic filaments or extrusions." [Col. 3, lines 63-67.] As further described in the Pall '881 patent, the extruded plastic netting can be provided in a variety of patterns, including an open weave pattern with extruded links of equal diameter in both directions, or with extruded links wider in one direction than in another, forming ribs extending lengthwise, or crosswise, or circumferentially, of the netting. [See generally, U.S. Patent No. 4,033,881, cols. 3 and 4.]

A spiral pleat filter element is comparable to a standard pleated filter in that it includes a plurality of longitudinal pleats disposed in a cylindrical configuration. In a spiral pleat filter, however, the ends of the pleats are rolled over to minimize the spacing between adjacent pleat surfaces near an outer diameter of the filter element, such that more filter surface area can be provided in a filter of equal diameter.

A conventional spiral pleated filter element is disclosed in U.S. Patent No. 5,543,047 to Stoyell et al. The spiral pleated filter element of the Stoyell '047 patent comprises a three layer composite of a filter medium, an upstream drainage layer disposed upstream relative to the filter medium, and a downstream drainage layer disposed downstream relative to the filter medium. The drainage layers disclosed in the Stoyell '047 patent "can be in the form of a mesh or screen or a porous woven or non-woven sheet." [Col. 5, lines 52-53.] The Stoyell '047 patent discloses a drainage layer that takes the form of an extruded polymeric mesh oriented and configured so that opposing surfaces of adjacent pleats are in intimate contact with one another over a substantial portion of the length of the filter element.

Additional patents directed to spiral pleat filter devices include U.S. Patent No. 2,395,449 to Briggs, and U.S. Patent No. 6,113,784 to Stoyell et al.

A further W-pleat design is disclosed in U.S. Patent No. 6,315,130 to Olsen.

While both the spiral pleat and the W-pleat designs provide surface-type filters with increased filter surface area, the spiral pleat designs do not have the pleat migration problems associated with the W-pleat designs. As compared with a W-pleat filter, however, the rolled-over pleats of a spiral pleated filter provide fewer and more difficult to access radial flow paths near the outer diameter of the filter, leading to a greater pressure drop across the filter. In addition, the rolled-over pleats of a spiral pleated filter provide longer flow paths and, therefore, a greater chance of the flow paths becoming blocked in high load or large particle contaminant applications.

Despite efforts to date, there is a continuing need for filter designs that offer increased filter area surface, improved flow/throughput for a given filter cartridge size and design and which are conducive to being inserted in an elongated cylindrical cartridge and prevent pleat migration.

→ 4a

EP 0470485 discloses a pleated filter element having longitudinally extending pleats and a wrap member wrapped around the filter member. The pleated filter element may comprise a composite having first and second extruded polymeric mesh layers and a filter layer positioned between them. The mesh can be fabricated from any polymeric material, including polyester, polypropylene or polyamide. EP '485 teaches that extruded polymeric mesh is generally preferable to other support and drainage material, including woven and nonwoven fibrous webs and polymeric netting. Polymeric beads may be applied along the downstream surface of the downstream support and drainage layer. EP '485 also teaches a method of applying continuous parallel beads by the application of a hot melt adhesive from an unevenly spaced multi-orifice dispensing head.

SUMMARY OF THE DISCLOSURE

According to one aspect, the present invention provides for a filter element as in claim 1.

According to another aspect, the present invention provides for a filter cartridge as in claim 12.

According to the present disclosure, advantageous filter elements may be provided that offer superior filtration performance including improved flow for a given filter cartridge size/design, the latter being achieved through the selection of support materials that act cooperatively to improve total flow.

A filter element constructed according to the present disclosure includes a filtration media, an upstream pleat support positioned upstream and in contact with the filtration media, multi-layer downstream pleat supports positioned downstream from the filtration media, including a first downstream support layer and a second downstream support layer:

(a) The first downstream support layer is in contact with the filtration media and is interposed between the filtration media and the second downstream layer, with the first downstream support layer having been fabricated so as to minimize points of surface contact with the filtration media.

(b) The second downstream support layer is in contact with the first downstream support layer and is fabricated so as to facilitate lateral fluid flow relative to the multi-layer downstream pleat support.

More particularly, the multi-layer downstream pleat support includes a first downstream support layer and a second downstream support layer. The first downstream support layer is interposed between the filtration media and the second downstream support layer and is fabricated so as to minimize points of surface contact with the filtration media, thereby enhancing fluid flow away from the filtration media. The first downstream support is fabricated from a material that contacts the membrane in as few locations as possible so as to allow the fluid, whether it be liquid or gas, to egress from the filtration media and into the second downstream support layer located just below. Suitable materials for use in fabricating the first downstream support layer are non-woven materials characterized by high air permeability, low thickness, high strength, low fiber diameter and/or a relatively soft feel to prevent abrasion of the filtration media. Preferred examples of materials for fabricating the first

support layers are polypropylene or polyesters. In an alternative embodiment, the first downstream support layer can be fabricated of a nonwoven material that is laminated to the filtration media. However, it is generally preferred to provide the first downstream support layer in non-laminated juxtaposition relative to the filtration media, thereby improving flow through the first support layer and the filtration media, e.g., by as much as 3 to 5%.

According to the present disclosure, the second downstream support layer is in contact with the first downstream support layer and is fabricated so as to facilitate lateral fluid flow. Preferably, the second downstream support layer is fabricated from an extruded apertured film material, and preferably an apertured film material having rib(s) formed on one side. The rib(s) advantageously maintain a gap when the pleated filtration media is folded onto itself, thereby greatly improving lateral fluid flow.

The inventors herein have established (infra) that eliminating either the first or the second downstream support layer will degrade the performance of the filter. The first downstream support layer, which is typically fabricated from a nonwoven material, does not provide optimum lateral flow. Likewise, the extruded apertured film would disadvantageously effect a sealed contact against the filtration media if placed directly against it, thereby limiting fluid egress from the filtration media to aperture locations. The addition of the support layers to the filter design allows an increase in the media area without resorting to different pleat designs, larger geometries or ever thinner supports, despite the fact that the additional support layers effectively add thickness. The relatively thin filtration media is capable of increased packing by pressing the pleats together more closely, but in prior art systems, the increased area associated with tight packing does not result in increased flow because the support materials are closely pinched together. It has now been found that when multiple downstream support layers are employed, as described in the present disclosure, the higher filtration area will beneficially lead directly to improved flow because the transport of the fluid from the downstream layers to the core will not be impeded. However, even when the filler element is constructed with less filtration area, the construction in accordance with the invention provides improved flow rate and improved flux, i.e., flow per area.

The filtration media may take a variety of forms, as are known in the art. Pleated filtration media having a plurality of longitudinally extending pleats may be advantageously incorporated into filter elements according to the present disclosure. The specific pleat geometry is not critical to the superior performance achievable according to the present disclosure. Radial pleats, W-pleats and spiral pleats are exemplary pleat geometries contemplated for use herein.

The disclosed filter elements may be utilized in filter cartridges, preferably cylindrical cartridges although the filter elements may be used to equal advantage with non-cylindrical filtration devices (planar filtration devices) and non-radial pleat constructions (spiral pleats), to provide enhanced filtration performance, e.g., by way of increased media area and improved flow. An exemplary filter cartridge according to the present disclosure includes a filter element having a longitudinal axis, an outer periphery and an inner periphery. The filter element typically includes a filtration media, an upstream pleat support positioned upstream from and in contact with said filtration media, and a multi-layer downstream pleat support positioned downstream from said filtration media, as disclosed herein. Exemplary filter cartridges according to the present disclosure also typically include a perforated, preferably cylindrical, cage surrounding the outer periphery of the filter element, a perforated, preferably cylindrical, core surrounded by the inner periphery of the filter element coaxially positional between the core and the cage. The cartridge assembly is coaxially positioned within the cage. It is necessary to seal the ends of the pleated element to prevent flow from bypassing around the edges. As is well known in the art, this is accomplished through the use of end caps. The end cap must be made of a material which first achieves a flow state so it can envelope the edge of the pleat structure and then harden to make a permanent seal. One typical means of accomplishing this sealing action is through use of a thermomelt material such as polypropylene, polyethylene or polyester, which reaches the melt state through heating and hardens with cooling. An alternate method would be to use a thermoset, such as epoxy, or a thermoplastic, such as santoprene, which are in a liquid state initially but harden upon cure. The term "hard" as used herein is relative as santoprene is an elastomeric

material. It is highly preferred that the end caps also embed the cage and core to provide the filter with added rigidity and strength.

In accordance with an embodiment of the invention, in a separate step, the end caps are bonded with an adapter element that permits the filter to fit into different housings. However, it is also well known to combine end cap and adapter function into one part.

In accordance with an embodiment of the invention, in a separate step the end caps are combined with an adapter element to form a single part that allows the filter element to more easily be fitted into the filter housing.

The non-cylindrical filtration devices and the non-radial constructions likewise benefit from the multi-layer supports of the invention in both up and downstream positions due to the greater pleat compression of the upstream or outer periphery pleats. Included without limitation are those filter elements as the spiral pleated filter elements having a plurality of longitudinally extending pleats which are designed so that adjacent pleats are laid-over upon one another to form the spiral pleats and multi-layer paper sheet filter cartridges in which a plurality of paper filter sheets of differing pore sizes are arranged in sequence of fluid flow therethrough according to decreasing pore size and which are formed in a concentric corrugated tubular configuration for fluid flow therethrough from one side to the other side as these would likewise benefit from multi-layer supports in both the up and downstream positions due to the greater compression of the upstream or outer periphery pleats in the spiral design and the relative weakness and therewith inability to withstand high differential fluid pressures without rupture in the multi-layer sheet design.

These and other aspects of the present disclosure will become more readily apparent to those having ordinary skill in the art from the following detailed description of exemplary embodiments taken in conjunction with the drawings described hereinbelow.

BRIEF DESCRIPTION OF THE DRAWINGS

So that those having ordinary skill in the art to which the present disclosure relates will more readily understand how to make and use the disclosed filter elements,

exemplary embodiments thereof will be described in detail hereinbelow with reference to the drawings, wherein:

Fig. 1 is a perspective view, partially cutaway, of a cartridge assembly including a pleated filter element constructed in accordance with an exemplary embodiment of the present disclosure contained between an inner core and an outer cage of the cartridge assembly wherein a portion of the filter element is shown unwrapped from within the cage.

Fig. 2 is a perspective, partially exploded, view of a portion of an exemplary filter element, illustrating the multi-layer structure thereof; and

Fig. 3 is a schematic cross-sectional illustration showing fluid flow relative to an exemplary filter element according to the present disclosure.

DETAILED DESCRIPTION OF PREFFERED EMBODIMENT(S)

According to the present invention, advantageous filter elements are provided that offer superior filtration performance by providing a selection of support layers that act cooperatively to greatly enhance flow. Exemplary filter elements according to the present disclosure include a filtration media, an upstream pleat support and a multi-layer downstream pleat support. The filtration media may take a variety of forms, as are known and conventional in the art. Pleated filtration media having a plurality of longitudinally extending pleats may be advantageously incorporated into filter elements according to the present invention. The specific pleat geometry is not critical to the superior performance achievable according to the present disclosure. Radial pleats, W-pleats and spiral pleats are exemplary pleat geometries contemplated for use herein.

The filtration media is typically fabricated from a microporous filtration membrane having a pore size of about 0.1 microns to about 10 microns. The pore size is typically characterized by a bubble point method, as is known in the art. The filtration medium can be fabricated from conventional filtration materials, such as expanded Teflon, nylon, polyether sulfone, polyvinylidene difluoride and the like.

Selection of an upstream pleat support according to the present disclosure is not critical to filtration performance and its selection generally depends upon a number of

factors, e.g., requirements associated with the upstream support's ability to maintain flow under dirt loading, the required chemical resistance of the upstream support, and/or issues associated with potential damage to the filtration media caused by the upstream support.

The multi-layer downstream pleat support includes a first downstream support layer and a second downstream support layer. The first downstream support layer is interposed between the filtration media and the second downstream support layer. In an exemplary embodiment of the present disclosure, the first downstream support layer is fabricated using a material made by the conventional spunbond, spunlace, airlaid or wetlaid techniques. The first downstream support layer is fabricated so as to minimize points of surface contact with the filtration media, thereby enhancing fluid flow away from the filtration media. More particularly, the first downstream support is fabricated from a material that contacts the membrane in as few locations as possible so as to allow the fluid, whether it be liquid or gas, to egress from the filtration media and into the second downstream support layer arranged just below.

Preferred first downstream support layers are fabricated from materials such as polyamide, polypropylene or polyester, e.g., poly(ethylene terephthalate) (PET), poly(butylene terephthalate (PBT), PTT or polyaramide. A preferred material for use in fabricating the first downstream support layer is BBA Nonwoven Typar 3091L, although other nonwoven materials that minimize points of surface contact with the filtration media are also suitable for use according to the present invention.

The nonwoven material may be made using thermal binding techniques or chemical binders. Suitable materials for use in fabricating the first downstream support layer are characterized by high air permeability, low thickness, high strength, low fiber diameter and/or a relatively soft feel to prevent abrasion of the filtration media. In some applications, it may be desirable to impart chemical or oxidation resistance to the first downstream support layer, as will be apparent to persons skilled in the art based on the intended filtration application(s).

In an alternative embodiment of the present invention, the first downstream support layer is a nonwoven material that is laminated to the filtration media.

Lamination may be effected according to conventional lamination techniques, as are well known in the art. However, as noted above, it is generally preferred to provide the first downstream support layer in non-laminated juxtaposition relative to the filtration media, thereby improving flow through the first support layer and the filtration media, e.g., by as much as 3 to 5%.

According to the present invention, the second downstream support layer is in contact with the first downstream support layer and is fabricated so as to facilitate lateral fluid flow. In accordance with a preferred embodiment, the second downstream support layer is fabricated from an extruded apertured film material, and preferably an apertured film material having rib(s) formed on one side. The rib(s) advantageously maintain a gap when the pleated filtration media is folded onto itself, thereby greatly improving lateral fluid flow. A preferred material for use in fabricating the second downstream support layer is Delstar Delnet RC-0707-24P.

In accordance with the present invention, it has been found that eliminating either the first or the second downstream support layer degrades the performance of the filter. As noted above, the first support layer, which is typically fabricated from a nonwoven material, does not provide optimum lateral flow, whereas the extruded apertured film would disadvantageously effect an undesirable sealed contact against the filtration media if placed directly against it, thereby limiting fluid egress from the filtration media to aperture locations.

In order to establish that utilizing both a first and second support layer in the filter design results in improved air flow performance, the inventors constructed nine cartridges, groups of three of which correspond to one of the following three groups:

Group 1 (according to the invention) including both a first downstream support layer and a second downstream support layer.

Group 2 the first downstream support layer is eliminated (nonwoven material).

Group 3 the second downstream support layer is eliminated (extruded apertured film).

All of the pleat packs were cut to a constant 5.75" in length as opposed to keeping the number of pleats constant per pleat pack. This served to maintain a constant pleat compression within the pack and eliminated a pleat separation condition which can lead to end cap failures.

Airflow and Water Flow Rate Testing was carried out using conventional procedures on the three cartridges constituting each of the three groups. Effective Filtration Area (EFA) was measured for each of the cartridges after testing was completed. Analysis of tests results follow. Flow performance results were also normalized for EFA.

Airflow

Airflow testing was conducted at vent conditions and at 30 psig. On average, at both conditions the cartridges in groups 2 and 3 lost 30% of their airflow performance compared to the control group. Table 1 show the airflow at vent conditions and Table 2 the airflow at 30 psig.

Table 1

	Cartridge ID	Measured EFA (ft^2)	Airflow at vent at 0.5 psid (scfm)			Flow Efficiency %
			Recorded Data	Normalized per ft^2	Normalized for standard EFA*	
Group 1	2690-166-0002	11.64	40.2	3.5	38.0	100%
	2690-166-0005	11.19	41.7	3.7	41.0	
	2690-166-0006	11.19	41.5	3.7	40.8	
Group 2	2690-166-0015	15.69	41.5	2.6	29.1	70%
	2690-166-0019	16.40	42.1	2.6	28.2	
	2690-166-0020	17.36	42.0	2.4	26.6	
Group 3	2690-166-0010	15.18	35.6	2.3	25.8	63%
	2690-166-0011	14.85	35.8	2.4	26.5	
	2690-166-0014	15.69	33.1	2.1	23.2	

*EFA standard 11.0 ft^2

Table 2

	Cartridg ID	Measure EFA (ft^2)	Airflow at 30 psig at 0.5 psid (scfm)			Flow Efficiency %
			Recorded Data	Normalized per ft^2	Normalized for standard EFA*	
Group	2690-166-	11.64	74.2	6.4	70.1	100
	2690-166-	11.19	76.7	6.9	75.4	
	2690-166-	11.19	79.4	7.1	78.1	
Group	2690-166-	15.69	78.4	5.0	55.0	71
	2690-166-	16.40	80.0	4.9	53.7	
	2690-166-	17.36	79.1	4.6	50.1	
Group	2690-166-	15.18	75.4	5.0	54.6	71
	2690-166-	14.85	72.9	4.9	54.0	
	2690-166-	15.69	70.4	4.5	49.4	

*EFA 11. f^2

Water Flow Rates

Water flow rate testing established that both groups 2 and 3 had an average decrease of 36% for water flow efficiency.

Table 3

	Cartridge ID	Measured EFA (ft^2)	Flow per Differential Pressure (gpm/psid)			Flow Efficiency %
			Calculated Data	Normalized per ft^2	Normalized for standard EFA*	
Group 1	2690-166-0002	11.64	3.53	0.30	3.3	100%
	2690-166-0005	11.19	4.00	0.36	3.9	
	2690-166-0006	11.19	3.75	0.34	3.7	
Group 2	2690-166-0015	15.69	3.16	0.20	2.2	61%
	2690-166-0019	16.40	3.33	0.20	2.2	
	2690-166-0020	17.36	3.53	0.20	2.2	
Group 3	2690-166-0010	15.18	3.75	0.25	2.7	66%
	2690-166-0011	14.85	3.53	0.24	2.6	
	2690-166-0014	15.69	2.73	0.17	1.9	

*EFA standard 11.0 ft^2

The addition of support layers to the filter design in accordance with the invention allows for an increase in the media area without resorting to different pleat designs, larger geometries or ever thinner supports, despite the fact that the additional support layers effectively add thickness. The relatively thin filtration media is capable of increased packing by pressing the pleats together more closely, but as in prior art systems, the increased area associated with tight packing does not result in increased flow because the support materials have been closely pinched together. However, when multiple downstream support layers are employed, as described in the present invention, enhanced filtration performance has been observed and namely an improved flow rate and improved flux (flow per area).

The disclosed filter elements may be utilized in filter cartridges to provide enhanced filtration performance, e.g., by way of increased media area and improved flow.

An exemplary filter cartridge according to the present disclosure includes a filter element having a longitudinal axis, an outer periphery and an inner periphery. The filter element typically includes a filtration media, an upstream pleat support positioned upstream from and in contact with the filtration media, and a multi-layer downstream pleat support positioned downstream from the filtration media. The multi-layer downstream support includes a first downstream support layer and a second downstream support layer. It has been found that while it is preferred that there be an upstream pleat support, its presence is not essential to the beneficial results realized in accordance with the invention.

The first downstream support layer is in contact with the filtration media and is interposed between the filtration media and the second downstream layer, the first downstream support layer being fabricated so as to minimize points of surface contact with the filtration media.

The second downstream support layer is in contact with the first downstream support layer and is fabricated so as to facilitate lateral fluid flow relative to the multi-layer downstream pleat support.

The filter cartridges according to the present invention also typically include a perforated cage surrounding the outer periphery of the filter element, a perforated core surrounded by the inner periphery of the filter element coaxially positioned within the cage, and end caps enclosing the ends of the perforated cage.

DETAILED DESCRIPTION OF THE DRAWINGS

Referring now to the drawings wherein like reference numerals identify similar structural elements of the present disclosure, there is illustrated in Fig. 1 a pleated filter cartridge constructed according to the invention and designated generally by reference numeral 10.

Filter cartridge 10 includes an elongated pleated filter element 12 having a plurality of longitudinal pleats 14 surrounding a central perforated core 20 coaxially disposed within the filter element and a perforated outer cage 30 coaxially disposed on the filter element. The core 20 supports the inner periphery of the filter element 12 against forces in the radial direction and also helps to give the filter axial strength and

rigidity against bending. The cage 30 retains the pleats of the filter element 10, preferably in a radial pleat configuration. It is possible to employ means other than cage 30 to retain the pleats as, for example, a polymeric netting or mesh material may be utilized to retain the pleats about the outer periphery of filter element 12. Usually a cartridge assembly 10 will be equipped with end caps at both ends. The end caps 40 can be either closed or open end caps and the materials of which they are formed and their shape are selected depending on the filtering conditions and the materials of the members to which they are to be joined.

When the filter element 12 is used under conditions where the fluid flows radially inwardly through the filter element, i.e., from the cage 30 to the core 20, the internal surfaces of the pleat legs form the downstream surface of the filter element 12, while the external surfaces of the pleat legs form the upstream surface of the filter element 12. Conversely, when the filter element 12 is used under conditions such that fluid flows radially outwardly through the element, i.e., from the core to the cage, the internal surfaces of the pleat legs define the upstream surface of the filter element 12 and the external surfaces of the pleat legs define the downstream surface of the filter element 12. More specifically, as used herein, upstream and downstream refer to the exterior and interior surfaces of the filter element 12 when the filter element is being subject to radially outward fluid flow.

Filtration element 12 includes an upstream pleat support 16, a filtration media 18, a multi-layer downstream support that includes a first downstream support layer 19 and a second downstream support layer 22. Selection of an upstream pleat support 16 is not critical to filtration performance and its selection generally depends upon a number of factors, namely, requirements associated with the upstream support's ability to maintain flow under dirt loading, the required chemical resistance of the upstream support, and/or conditions associated with potential damage to the filtration media caused by the upstream support.

The filtration media 18 may take a variety of pleated forms, the filtration media 18 may define radial pleats, W-pleats or spiral pleats.

There are no particular restrictions on the type of filter medium 18 that can be employed in the present filter element 12 and the filter medium can be selected in accordance with he fluid to be filtered and the desired filtering characteristics. The filter medium 18 can be used to filter fluids such as liquids, gases, or mixtures thereof, and may comprise a porous film or a fibrous sheet or mass, or any combination thereof, may have a uniform or graded pore structure and any appropriate effective pore size; may include single or multiple layers; and may be formed from any suitable material, such a natural material, synthetic polymer, glass or metal.

According to preferred embodiments of the present disclosure, the filter medium is comprised of one or more sheets of non-woven thermoplastic microfibers. The nonwoven thermoplastic microfibers may be meltblown, spunbond, spunlace, carded or hydroentangled, for example. In addition, the filter medium may be calendered, or compressed, to further modify its porosity. For lower temperature filtering applications (i.e., below 180° F.), the thermoplastic can comprise polypropylene, for example, while for higher temperature applications (i.e., above 180° F.) or chemical compatibility with other fluids, the thermoplastic can comprise polyaramide, nylon, polyester or melt-processible fluoropolymer, for example.

The filtration media 18 is typically a microporous filtration media having a pore size of about 0.1 microns to about 10 microns, and is generally fabricated from conventional filtration materials, such as expanded Teflon, nylon, polyether sulfone, polyvinylidene difluoride and the like.

The pore size of filtration media 18 is generally characterized by bubble point tests, which involve measuring the pressure to force either the first air bubble out of a fully wetted phase inversion membrane (the initial Bubble Point, or "IBP"), and the higher pressure which forces air out of the majority of pores all over the phase inversion membrane (foam-all-over-point or "FAOP"). The procedures for conducting initial bubble point and FAOP tests are discussed in U.S. Patent No. 4,645,602, the disclosure of which is incorporated herein by reference. The procedure for the initial bubble point test and the more common Mean Flow Pore tests are explained in detail, for example, in ASTM F316-70 and ANS/ASTM F316-70 (Reapproved 1976), which

are incorporated herein by reference. The bubble point values for microporous phase inversion membranes are generally in the range of about five (5) to about one hundred (100) psig, depending on the pore size and the wetting fluid. An additional pore measurement technique is described in ASTM E1294 89, which describes a method for determining pore size by clearing fluid from the pores of the membrane and measuring the resulting flow. This method is used to measure mean flow pore and is similar to the method used to measure bubble point, and reports the initial bubble point as the maximum pore size.

As shown in Figs. 1-3, the first downstream support layer 19 is interposed between filtration media 18 and second downstream support layer 22. In an exemplary embodiment of the present disclosure, the first downstream support layer 19 is fabricated using spunbond, spunlace, airlaid or wetlaid techniques, and is fabricated so as to minimize points of surface contact with filtration media 18, thereby enhancing fluid flow away from filtration media 18. More particularly, the first downstream support layer 19 is generally fabricated from a material that contacts the filtration media 18 in as few locations as possible so as to allow the fluid, whether it be liquid or gas, to egress from filtration media 18 and into the second downstream support layer 22.

The fluid flow through the filter elements according to the present disclosure is schematically illustrated in Fig. 3, wherein horizontal arrows "H" show fluid flow through the first downstream support layer 19, away from filtration media 18 and toward second downstream support layer 22. The vertical arrows "V" show lateral fluid flow that is facilitated by the physical properties of second downstream support layer 22. Lateral fluid flow associated with the second downstream support layer 22 feeds filtered fluid toward the egress point associated with exemplary filter element 12, e.g., toward core 20.

The first downstream support layers are preferably fabricated from materials such as polyamide, polypropylene or polyesters, e.g., poly(ethylene terephthalate) (PET), poly(butylene terephthalate (PBT), PTT or polyaramide. A preferred material for use in fabricating the first downstream support layer is BBA Nonwoven Typar

3091L, although other nonwoven materials that minimize points of contact with the filtration media are also suitable for use according to the present disclosure. Beneficial attributes for nonwoven materials that may be used in fabricating the first downstream support layer according to the present disclosure are lower denier (i.e., lower fiber diameter), low basis weight (provided adequate web strength is maintained), and low thickness. As noted above, however, a guiding principle in selecting an appropriate material for fabrication of the first downstream layer is to provide minimal contact points with the filtration media and high flow through the nonwoven layer, while still providing adequate strength.

The fibers forming the nonwoven material may be bonded together with thermal binders or chemical binders. Suitable materials for use in fabricating the first downstream support layer generally are characterized by high air permeability, low thickness, high strength, low fiber diameter and/or a relatively soft feel to prevent abrasion of the filtration media. In some applications, it may be desirable to impart chemical or oxidation resistance to the first downstream support layer, as will be apparent to persons skilled in the art based on the intended filtration application(s). In an exemplary embodiment of the present disclosure, the first downstream support layer is a nonwoven material that is laminated to the filtration media. Lamination may be effected according to conventional lamination techniques, as are well known in the art.

According to the present disclosure, the second downstream support layer is in contact with the first downstream support layer and is fabricated so as to facilitate lateral fluid flow. Thus, in a preferred embodiment of the present disclosure, the second downstream support layer is fabricated from an extruded apertured film material, and preferably an apertured film material with rib(s) formed on one side. The rib(s) advantageously maintain a gap when the pleated filtration media is folded onto itself, thereby greatly improving lateral fluid flow. A preferred material for use in fabricating the second downstream support layer according to the present disclosure is Delstar Delnet RC-0707-24P.

Many different filtration devices will benefit from the superior performance attributes as disclosed herein. For example, the disclosed multi-layer downstream

support layers may prove particularly beneficial to Teflon filtration media used in air applications and hydrophobic PVDF filtration media, which are also used in air applications. Teflon membranes, in particular, may be laminated to a nonwoven support as part of the manufacturing process.

It is further contemplated that the disclosed multi-layer downstream support may be advantageously incorporated into a non-cylindrical filtration device. For example, it is contemplated that a filtration device that includes a multi-layer downstream support, as disclosed herein, and having a geometry wherein the outer and inner peripheries are substantially parallel to each other, will exhibit enhanced filtration performance by increasing filtration media area and improving flow/throughput. Indeed, it is to be expected that by incorporating the disclosed multi-layer downstream support in a substantially planar filtration device configuration, fluid flow (both through the filtration device and laterally relative to the filtration device) will be advantageously maintained, despite close packing of the pleats therewithin.

Although the filter elements and filter cartridges of the present disclosure have been described with respect to preferred embodiments, those skilled in the art will readily appreciate that changes and modifications may be made thereto without departing from the ~~spirit and~~ scope hereof as defined by the appended claims.

WHAT IS CLAIMED IS:

1. A filter element (12), comprising:

a filtration media (18);

an upstream filtration media support (16) positioned upstream from and in contact with said filtration media; and

a multi-layer downstream filtration media support (13, 22) positioned downstream from said filtration media, said multi-layer downstream support including a first downstream support layer (19) and a second downstream support layer (22), wherein:

(a) said first downstream support layer (19) is in contact with said filtration media (18) and is interposed between said filtration media and said second downstream layer (22), said first downstream support layer is fabricated so as to minimize points of surface contact with said filtration media; and

(b) said second downstream support layer (22) is in contact with said first downstream support layer and is fabricated so as to facilitate lateral fluid flow relative to said multi-layer downstream ~~pleat~~ support, wherein said second downstream support layer (22) comprises an extruded apertured film. ~~element~~ having ribs.

2. A filter element as recited in Claim 1, wherein the filtration media (18) is a pleated filtration media having a plurality of longitudinally extending pleats (14).

3. A filter element as recited in Claim 2, wherein the longitudinally extending pleats (14) of said pleated filtration media (18) are selected from the group consisting of radial pleats, w-pleats and spiral pleats.

4. A filter element as recited in Claim 1, wherein the filtration media (18) is a microporous filtration membrane having a pore size of from about 0.1 microns to about 10 microns.

5. A filter element as recited in Claim 1, wherein the filtration media (18) is fabricated from a material selected from the group consisting of Teflon, nylon, polyaramide, polyvinylidene difluoride, polyether sulfone and combinations thereof.

6. A filter element as recited in Claim 1, wherein the multi-layer downstream support (19,22) consists of said first downstream support layer and said second downstream support layer.

7. A filter element as recited in Claim 1, wherein said first downstream support layer (8) is fabricated from a nonwoven material.

8. A filter element as recited in Claim 7, wherein said nonwoven material is laminated to said filtration media (18).

9. A filter element as recited in Claim 7, wherein said nonwoven material is fabricated as a spunbond, spunlace, airlaid or wetlaid material.

10. A filter element as recited in Claim 7, wherein said nonwoven material is fabricated from polypropylene, polyester or polyamide.

11. A filter as recited in Claim 1, wherein said extruded apertured ~~element~~ film (22) has ribs on one side.

12. A filter element, comprising:

a filtration media;

an upstream pleat support positioned upstream from and in contact with said filtration media; and

a multi-layer downstream pleat support positioned downstream from said filtration media, said multi-layer downstream support including a first downstream support layer and a second downstream support layer, wherein:

(a) said first downstream support layer is in contact with said filtration media and is interposed between said filtration media and said second downstream layer, said first downstream support layer is fabricated so as to minimize points of surface contact with said filtration media; and

(b) said second downstream support layer is in contact with said first downstream support layer and is fabricated so as to facilitate lateral fluid flow relative to

said multi-layer downstream pleat support, wherein said second downstream support layer comprises an extruded apertured element having ribs.

12. ~~11~~ A filter cartridge comprising:

according to any one of claims 1 to 11, the filter element (12)

a filter element having a longitudinal axis, an outer periphery and an inner periphery; and ~~and including a filtration media, an upstream filter media support positioned upstream from~~ and in contact with said filtration media; and a multi-layer downstream support positioned downstream from said filtration media, said multi-layer downstream support including a first downstream support layer and a second downstream support layer, wherein:

(a) the first downstream support layer is in contact with said filtration media and is interposed between said filtration media and said second downstream layer, said first downstream support layer being fabricated so as to minimize points of surface contact with said filtration media; and

(b) the second downstream support layer is in contact with said first downstream support layer and is fabricated so as to facilitate lateral fluid flow relative to said multi-layer downstream filter media support, wherein said second ~~downstream support layer comprises an extruded apertured element having ribs;~~

the filter cartridge (10) further including:

a perforated cage (30) surrounding the outer periphery of the filter element;

a perforated core (20) surrounded by the inner periphery of the filter element; and

end caps (40) enclosing both ends of the perforated cage.

14. A filter cartridge as recited in Claim 13, wherein said first downstream support layer is fabricated from a nonwoven material.

15. A filter cartridge as recited in Claim 14, wherein said nonwoven material is laminated to said filtration media.

16. A filter element as recited in Claim 14, wherein said nonwoven material is fabricated as a spunbond, spunlace, airlaid or wetlaid material.

17. A filter element as recited in Claim 14, wherein said nonwoven material is fabricated from polypropylene, polyester or polyamide.

18. A filter element as recited in Claim 13, wherein said second downstream support layer is an extruded apertured element having ribs.

19. A filter element as recited in Claim 13, wherein said second downstream support layer is an extruded apertured element having ribs formed on one side.

20. A filter cartridge as recited in Claim 13 wherein the perforated cage is equipped with end caps at both ends thereof.

13. ~~21~~ A filter cartridge as recited in Claim 12 wherein said perforated core (20) is a cylindrical core and is coaxially positioned within the filter element which is a cylindrical filter element and the cage (30) is likewise cylindrical and is coaxially positioned about the cylindrical filter element.

22. A filter cartridge comprising:

a filter element having a longitudinal axis, an outer periphery and an inner periphery, and including a filtration media; and a multi-layer downstream pleat support positioned downstream from said filtration media, said multi-layer downstream support including a first downstream support layer and a second downstream support layer, wherein:

(a) the first downstream support layer is in contact with said filtration media and is interposed between said filtration media and said second downstream layer, said first downstream support layer being fabricated so as to minimize points of surface contact with said filtration media; and

(b) the second downstream support layer is in contact with said first downstream support layer and is fabricated so as to facilitate lateral fluid flow relative to said multi-layer downstream pleat support, wherein said second downstream support layer comprises an extruded apertured element having ribs;

a perforated cage surrounding the outer periphery of the filter element;

a perforated core surrounded by the inner periphery of the filter element; and

end caps enclosing both ends of the perforated cage.

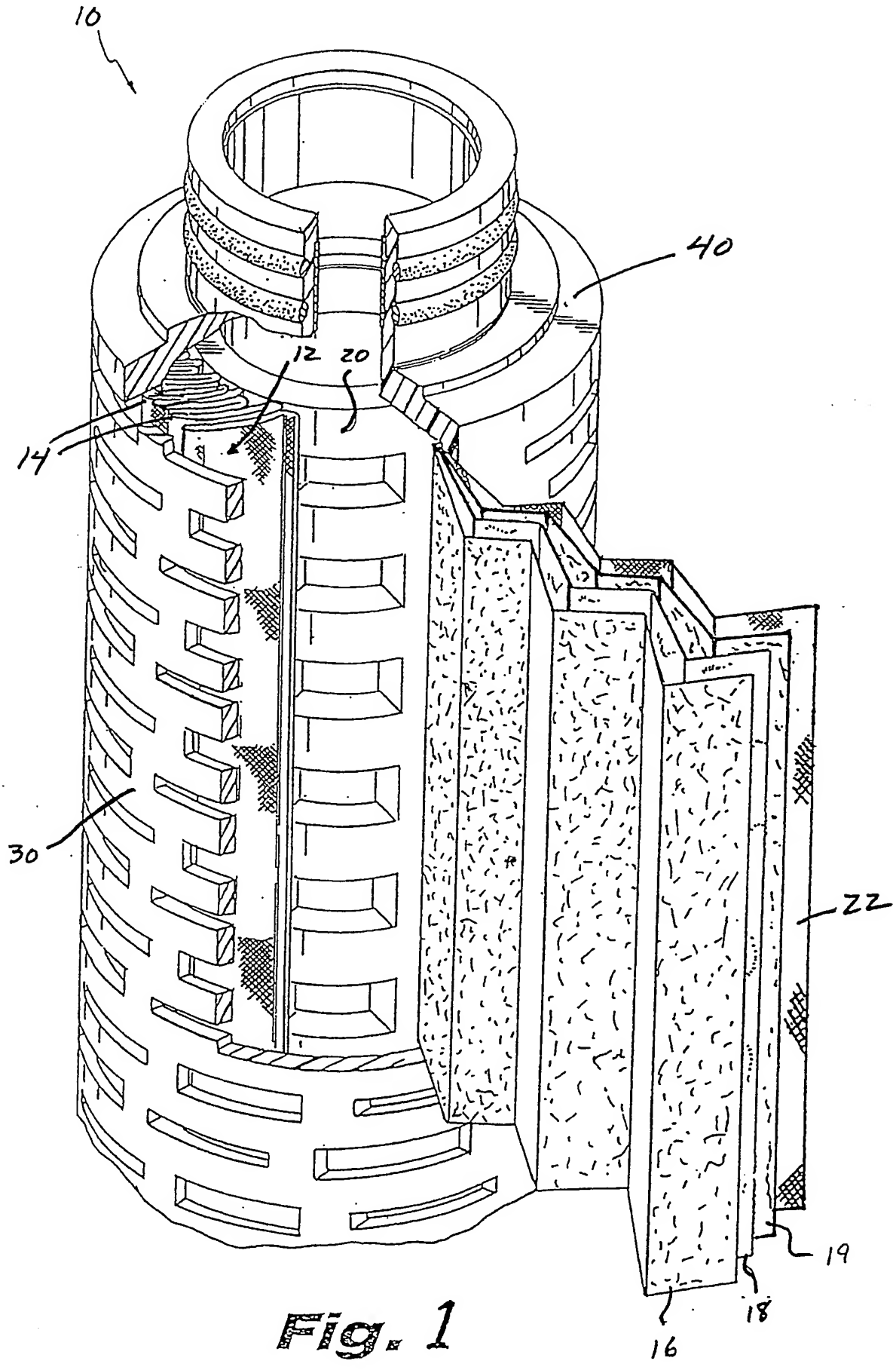

Fig. 1

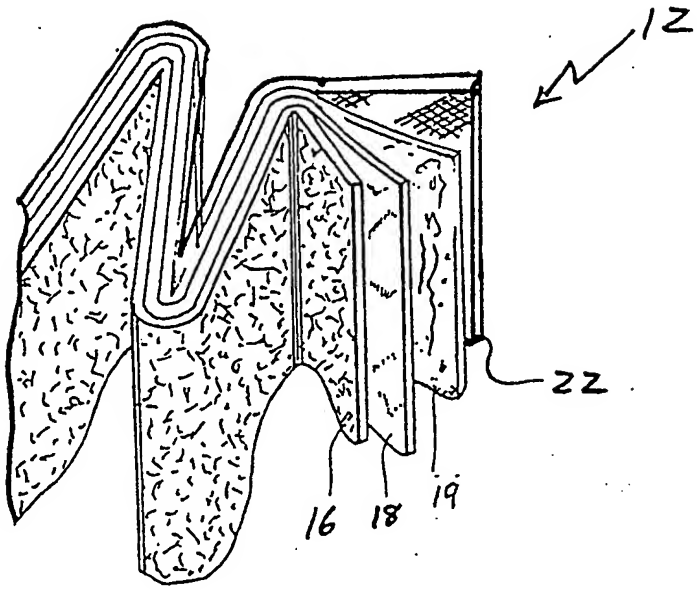

FIG. 2

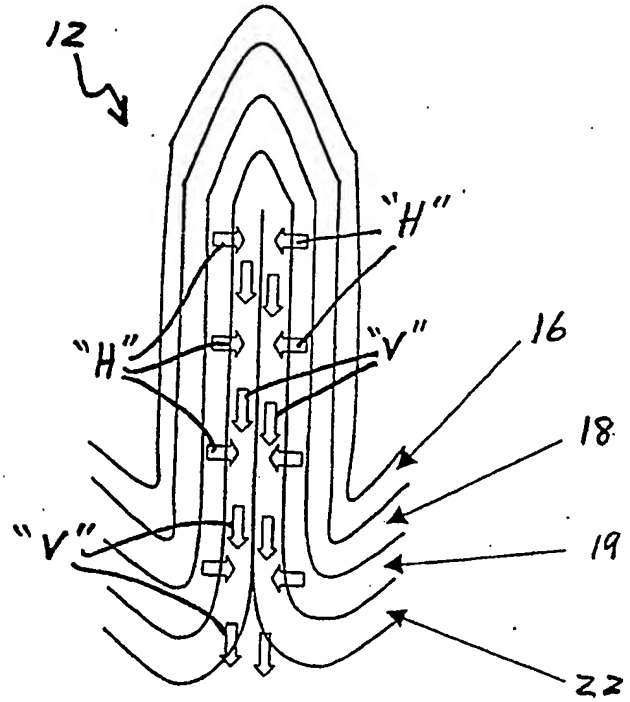

FIG. 3